CHRISTOPHER HOBBS'S MEDICINAL MUSHROOMS

THE ESSENTIAL GUIDE

- Boost Immunity
- Improve Memory
- Fight Cancer
- Stop Infection
- Expand Your Consciousness

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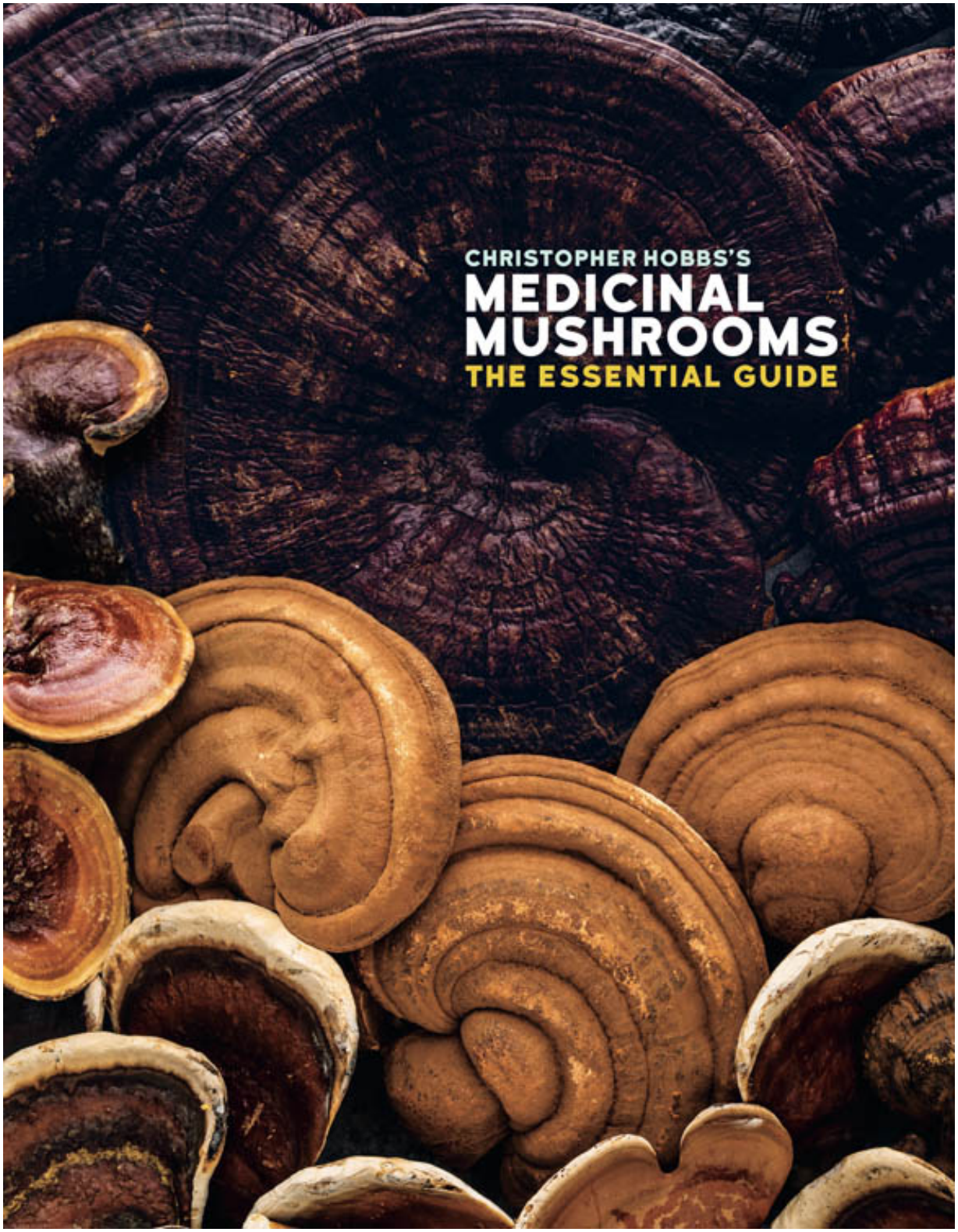
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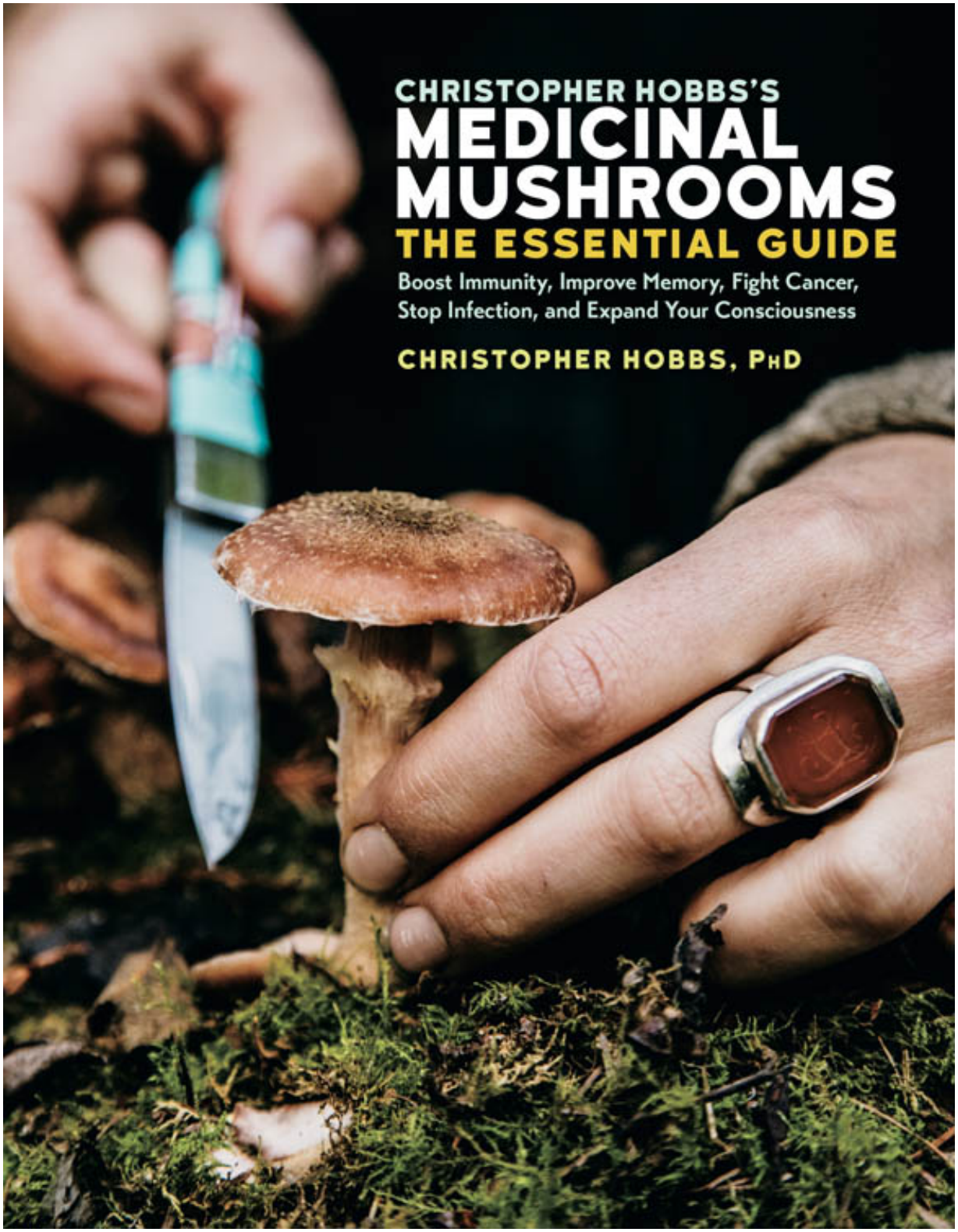
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CHRISTOPHER HOBBS, PHD

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Edited by Carleen Madigan

Art direction and book design by Carolyn Eckert

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Cover photography by © Tai Power Seeff, *except back b.r. by* © George Hergenhan/Alamy Stock Photo

Interior photography by © Tai Power Seeff

Photography styling by Annie Martin

Additional photography credits

Illustrations by Bessie Pease Gutmann/Wikimedia Commons, 195 b.; © Beverly Duncan, 32, 203; John Tenniel/British Library/Wikimedia, 174; © Karin Spijker, 28

Text © 2020 by Christopher Hobbs

Ebook production by Kristy MacWilliams

Ebook version 1.0
March 10, 2021

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Storey Publishing
210 MASS MoCA Way
North Adams, MA 01247
storey.com

Library of Congress Cataloging-in-Publication Data on file

TO MY SON, KEN,

who has taught me so much about service, humility, and love on an often joyful and sometimes difficult path to self-discovery and healing.

A NOTE OF CAUTION FROM THE PUBLISHER

The information in this book is provided only as a resource. Any reader who forages for wild mushrooms and chooses to ingest them does so at his or her own risk; without a 100 percent positive identification, no wild mushroom should ever be consumed. Readers should not rely solely the information in this book for the purpose of identifying mushrooms; consulting other respected field guides (listed in Resources) is necessary, and consulting with an expert mushroom forager, who can identify the mushrooms in person, is recommended.

The author's opinions about the uses and risks of taking psilocybin in Chapter 4 do not constitute either legal or medical advice.

Any reader who nevertheless elects to use psilocybin for any of the possible benefits advanced by the author should first consult a qualified medical professional, or an experienced or qualified guide, who can make recommendations based upon the reader's medical and psychological history and current medical and psychological condition.

The reader should carefully consider the following before foraging, preparing, or ingesting psilocybin:

Psilocybin is a Schedule 1 drug (classified by the United States Drug Enforcement Administration). The manufacture, possession, and distribution of psilocybin is illegal under federal, state, and almost all local laws.

The publisher does not encourage or advocate acting in any way that violates local, state, or federal laws and regulations.

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PREFACE

The inspiration for this book came from my ancestors, my passion for botany, nature, and science, as well as my lifelong interest in such questions as, *What causes disease? Why does it come to some people who seem perfectly healthy, despite their best efforts to take care of themselves in a good way? Is good health just the absence of disease, or something greater?*

These lifelong interests finally crossed with my passion for fungi in the late 1970s, when I attended one of the first mushroom conferences in the United States. It was on Orcas Island, the inspiration of Paul Stamets, the renowned mycophile. There I met Paul, as well as Dr. Alexander Smith, a wood sprite if I ever saw one, and a prominent mycologist and author of mushroom field guides; Dr. Gastón Guzmán, the leading researcher on the genus *Psilocybe*; and many more luminaries in this tribe of unique fungi enthusiasts. Mushroom identification walks and talks from Dr. Smith, Dr. Guzmán, and local mushroom experts set me off like a rocket on a trajectory of fascination for fungi that has lasted a lifetime. It was just a beginning, but from the conference I took away some entry-level identification skills that enabled me to recognize chanterelles and a few other worthy edibles. Over the years since then, my passion and identification skills have expanded; I now find and eat more than 50 wild species of mushrooms. When no wild mushrooms are around, I'm reduced to growing oyster mushrooms at home or purchasing various cultivated

fungi, as well as rehydrating the porcini and candycaps I dried the previous season.

My ancestors on my mother's side passed along their interest in community herbalism — my great-grandmother was an herbalist, and my grandmother was the community herbalist in her neighborhood of Pasadena, California, in the 1920s. On my dad's side, my grandfather was an organic grower of avocados and citrus. He had a compost heap in his orchard that I still remember, and a special canning kitchen where he

processed crops from his orchard and farm to store for winter. My dad taught botany and biology at a university until he retired, then spent his retirement years consulting on environmental issues.

All the epigenetic signals my ancestors passed on to me led me into the woods, where every turn was a mystery with an unknown destination. Along the way were the most fantastic creations of nature — brightly colored fungi of every hue, tall fragrant trees, rugged landscapes high in the mountains, green meadows tall with every wildflower, with a babbling stream running through it. What brought it all together and brought these treasures into my life fully was the community of herbalists and lovers of nature and fungi whom I met and loved, as we explored the edges of the well-trod pathways of mainstream culture.

ABOVE: I have been fascinated by fungi for decades. This is a mushroom walk I led at the Breitenbush Herbal Conference in the early 1990s.

It is estimated that there are 2.2 to 3.8 million species of fungi on Earth, of which only about 4 percent have been documented and described.

MY EARLY RESEARCH

In 1985, my interest in herbalism and natural health led me to begin researching how people have used fungi for healing and health in different cultures around the world. I also started combing the scientific literature for studies that might show the ways in which fungi affect our nutrition, metabolism, and immunity. This latter idea really struck me. Mushrooms and fungi could activate many aspects of our immune response, whose fundamental purpose is to protect us from pathogenic types of viruses and bacteria. According to traditional Chinese medicine, disease-promoting factors are created in our bodies through our constitution, diet, and metabolism, as well as external influences from the environment like hot, cold, dry, and damp. To the ancients, fungi like reishi could help remove these pathogens and restore healthy balance throughout our body's systems, enabling us to maintain homeostasis.

ORANGE PEEL FUNGUS

Aleuria aurantia

WOOLLY CHANTERELLE

Turbinellus floccosus

I was fascinated and powerfully attracted to learning more about how and why these interactions between fungi and humans happen. These interactions are ancient — fungi have been around for about 1 billion years, according to a recent

discovery based on fossils collected in northern Canada by an international team of researchers. [1] The previous estimate was about 460 million years. This research shows that fungi appeared on land prior to the evolution of flowering plants, prior to the rise of insects, and long before the evolution of mammals. Other research shows that our distant ancestors were interacting with fungi. It's no wonder, then, that we have developed sensors throughout our body to detect the presence of fungi.

Flacher Porling, Polyporus applanatus.

Großer Schirmpilz, Lepiota procera. Ehbar.

Pfifferling, Cantharellus cibarius. Ehbar.
Cauthorel

Fliegenpilz, Amanita muscaria. Giftig.
Vliegen zwam

ABOVE: These stunning illustrations are from an early German field guide I found while doing research in Europe.

In 1986, I wrote the first edition of *Medicinal Mushrooms: The History, Chemistry, Pharmacology and Folk Uses for Modern Times*. In 1995, I spent months researching and pulling together more than a thousand references to write the second edition of the book, greatly expanded, which is still in print today.

ABOVE: At the Mendocino Mushroom Foray, we found dozens of species.

ABOVE: *Mycena* species

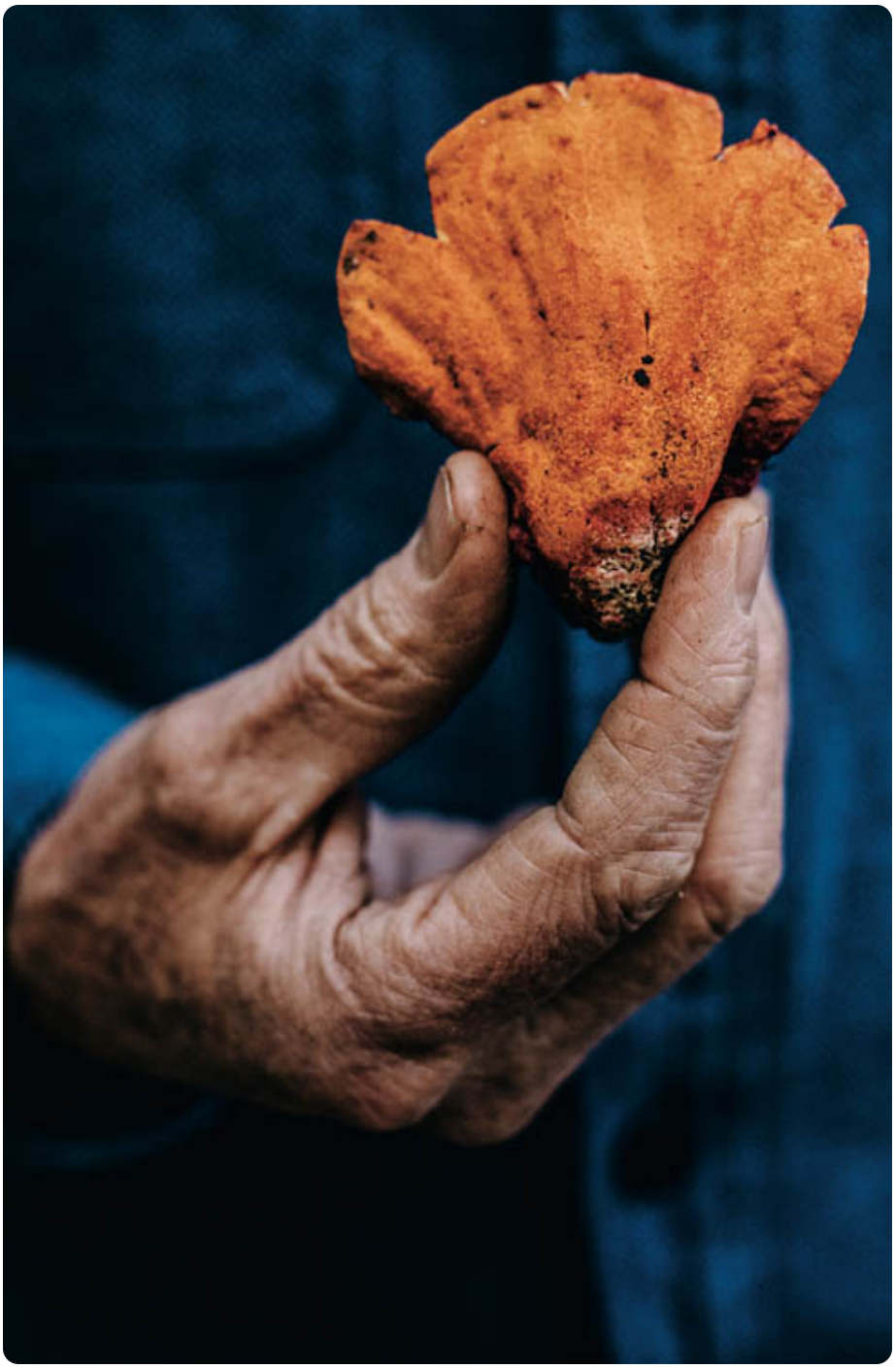
ABOVE: Inspecting a *Suillus* species

Since then, the scientific research and publication on the myriad ways fungi interact with our immune system and other body systems, as well as their disease-preventing and healing properties, have grown tremendously. Currently, the published scientific literature on turkey tail fungus alone is likely to rival all the combined literature that existed in 1985 on all species of fungi used for medicine by all world cultures. In 1985, about 70 studies were published based on the keywords “medicinal mushrooms” in the scientific literature. By 2019, that had grown to about 4,400.

Over more than 35 years of researching, writing, and speaking about the rich history of human-fungi interactions, I have learned from many passionate and curious students. The experiences they’ve shared with me and the questions they’ve asked have been enlightening and inspiring, and have helped direct my research. I’ve learned what people are curious about; the questions they ask are often focused on how to incorporate mushrooms into their daily lives. People want to know if medicinal mushrooms can help them resolve their health issues and stay healthy under stress or during the cold and flu season, and if they can help other members of their family.

THE HEALING POTENTIAL OF FUNGI

The purpose of this book is to address many of the common questions I receive from the people who attend the talks and workshops I have offered over the years, and to share the passion I have for fungi, health, and the natural world. I have included my hands-on experience, clinical experience with patients, and a distillation of my extensive research about medicinal fungi. I want to share the amazing story of how fungi interact with our body to activate global immune responses, help calm our nervous system, benefit our cardiovascular system, and protect us from toxins and stresses in our environment, all the while supplying important nutrients. The healing potential of fungi is promising indeed.



LOBSTER MUSHROOM

Hypomyces lactifluorum

DEER MUSHROOM

Pluteus cervinus

Exploring the world of fungi and connecting with them in the environments where they live — in fields and pastures, forests,

and compost heaps — contributes to good health. In this way, we experience the calm and reflection of “forest therapy,” the joy of going on mushroom-collecting forays for personal solitude, and the healing practice of mindfulness. We bond with family members and connect with friends as we explore, encouraging young children to feel connected to the natural world and building friendships. The excitement of the hunt for edible and medicinal fungi adds to the healing properties of the mushrooms themselves. Being in the forest, finding mushrooms, and experiencing the sensual qualities of fungal smells — often earthy, fresh, or even fruity — and the inviting textures of moist duff and silky mushrooms trigger ancient instincts. Every color of the rainbow is represented in the mushroom world, enhancing their appeal and making it easy to spot them.

When we turn our attention to nature, we receive her blessings, her nurturing, and her vast wisdom, which is so restorative and healing to mind, spirit, and body.

ABOVE: Clockwise from top left: *Stropharia ambigua*, *Lepiota* species, *Boletus edulis, Ganoderma applanatum*

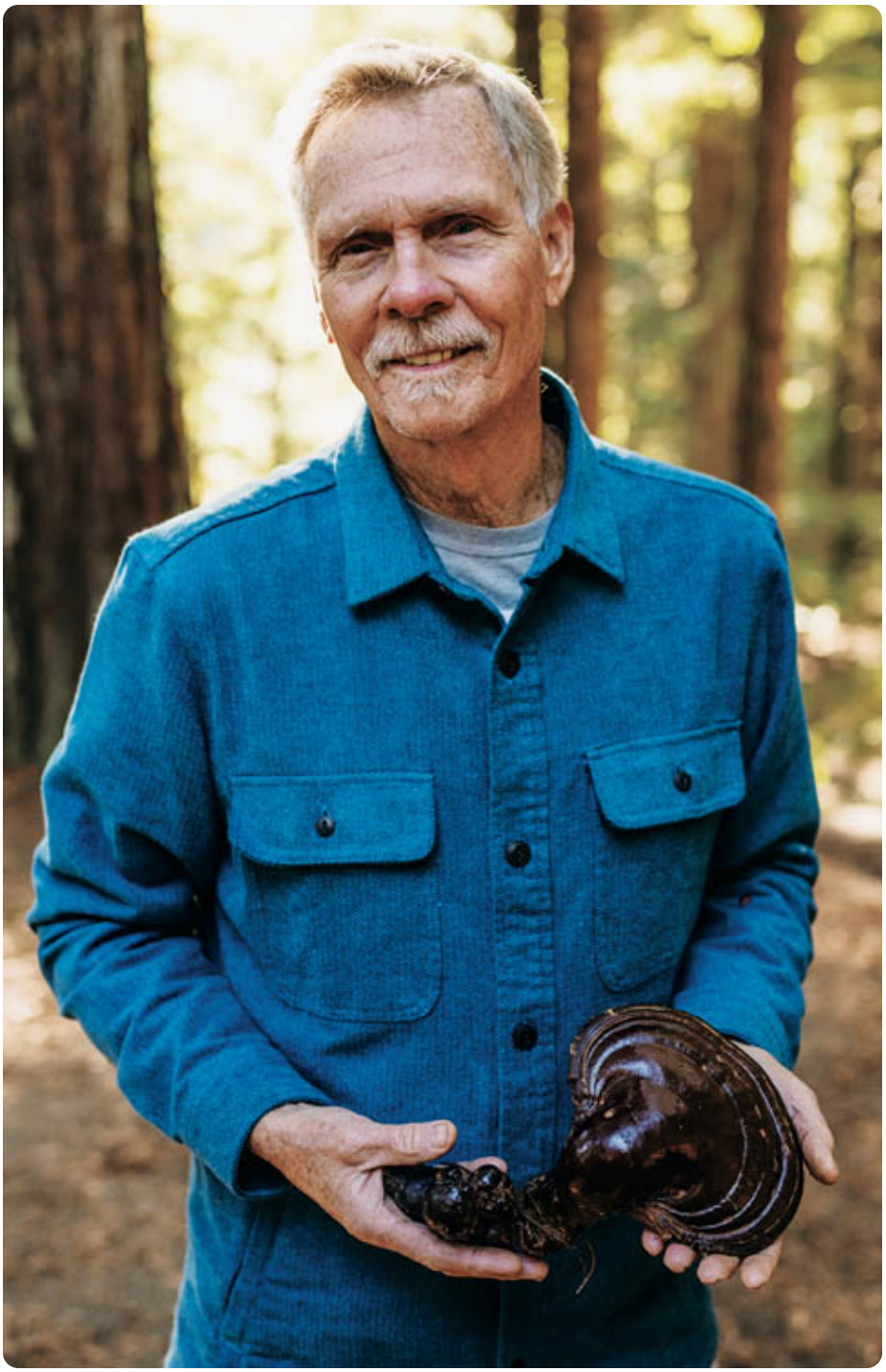
The scope of this book could be encyclopedic if we had the space to tell all the stories from world cultures, the uses of fungi in current herbal practice and as a medicine and food of the people in many countries of the world, as well as attempting to summarize the vast amount of scientific research that has been published. Instead, I focus on the information, hands-on instruction, recipes, and formulas that are imminently practical, and on the published studies that are most helpful in understanding the usefulness of a particular species.

The published studies I've included are typically randomized, double-blind, placebo-controlled studies, or actual clinical reports to help us understand the benefits to humans,

how to purchase high-quality products that are the most active, how to harvest medicinal species, how to prepare them, how to take them for oral use, and for how long. We will highlight the best species for many health conditions, and what, if any, are the potential side effects. Most importantly, we will discuss what to expect when using fungi for prevention and support to help heal various diseases — such as for cancer support, cardiovascular support, metabolic syndrome, and obesity; for preventing and treating various viral and bacterial infections, such as urinary tract infections and respiratory tract infections; for restoring and healing nerve problems; for cognition; for increasing energy; for easing mood disorders like depression and anxiety; and more. I will also share my years of clinical and personal experience collecting, extracting, making products, testing in the lab, and use with my patients in the clinic.

I hope this book answers many of your questions, so you can fully incorporate and enjoy the health and medicinal benefits of fungi in your daily life.

ABOVE: Shaggy mane (*Coprinus comatus*) is an edible species that's relatively easy to identify by its shaggy cap, among other traits.



ABOVE: *Ganoderma oregonense* is a beautiful species of reishi found in the Western United States.

1

MUSHROOMS FOR HEALTH AND HEALING

MUSHROOMS are a familiar food. Even the least adventuresome eater has probably enjoyed button mushrooms sliced up on a pizza, or shiitake in an Asian stir-fry. These mushrooms add pleasing textures, mouthfeel, and flavor to many meals. Despite their familiarity, though, many people aren't aware of the nutritional benefits of mushrooms. As a nutritional powerhouse, they have so much more than flavor and texture to offer. As you eat them and learn about their nutritional and medicinal benefits, you may start thinking of them as essential superfoods.

[redacted]

A HEALING AND HEALTHFUL FOOD

Hippocrates is thought to have said, “Let your food be your medicine and your medicine be your food.” This statement is more relevant than ever, now that modern science has found so many active and healing compounds in common foods like curcumin in turmeric and curry, allicin in garlic, quercetin in apples and onions, and the cancer-preventive compounds in brassica vegetables like broccoli and kale called Se-methylselenocysteine and glucosinolates.

Thinking of mushrooms as both food and medicine, as have many cultures throughout time, can encourage you to incorporate them in your daily diet. Taking pills or tinctures is another way of getting mushroom medicine, but because this is often separate from our regular lives and habits, developing a regimen of regular mushroom consumption with pills and tinctures can be hit or miss. Eating mushrooms frequently and using mushroom powders you’ve made yourself will enable you to get a higher dose and much greater benefit for the amount of money you spend, considering the production costs that go into making commercially available pills and extracts. (See Choosing Mushroom Products off the Shelf for further discussion of the variable quality of commercial mushroom products.)

Some species of edible mushrooms have a nearly complete complement of all necessary nutrients —

vitamins, minerals, fiber, protein, carbohydrates, and fatty acids. To absorb these nutrients, mushrooms should be well cooked to break down the tough fibers.

High in Minerals, B Vitamins, and Protein

When it comes to nutrition, mushrooms have so much to offer! They are a rich source of vitamins, and they have an incredibly high mineral content (some types have 7 to 12 percent total minerals); they are a particularly good source of trace minerals such as zinc, copper, and iron, as well as the macrominerals phosphorus and potassium. Mushrooms also have a significant amount of all the B-complex vitamins (including B_{12}) — almost as much as meat. Since B_{12} is a crucial vitamin for our body to create new, healthy blood cells, and meat is the highest and most bioavailable source, vegetarians can become deficient in this important nutrient. Cooking mushrooms helps break down cell walls and render the minerals more bioavailable. Heat can destroy some of the vitamins, but stir-frying mushrooms like oyster mushrooms and shiitakes with a little water will preserve a good portion of the B vitamins.

Fungi are also an excellent source of high-quality protein; some oyster mushrooms, for example, contain up to 30 percent protein. This makes mushrooms a valuable addition to the diet, especially in parts of the world where protein is scarce; fungi

can efficiently convert plant waste into a sustainable form of protein that humans can digest and assimilate efficiently. The protein in mushrooms contains all nine essential amino acids.

MAJOR NUTRIENTS FOR TEN IMPORTANT MUSHROOMS

Oyster

Pleurotus spp.

PROTEIN^ %	FATS %	SUGARS %
24.7–34.7	1.8–5	19.6
DIETARY FIBER %**	**MAGNESIUM MG/100 G**	**IRON MG/100 G**
66.4	128–190	9–15
POTASSIUM MG/100 G	**CALCIUM MG/100 G**	**COPPER MG/100 G**
2,722–5,100	89–150	2.6
PHOSPHORUS MG/100 G	**ZINC MG/100 G**	**THIAMIN*** MG/100 G**

618–1,339	3–12	0.042–0.3
RIBOFLAVIN** MG/100 G** 0.083–1.27	**NIACIN MG/100 G** 3.88–14.1	**FOLATE (MG/100 G)***** 13–163
VITAMIN D2* (MG/100 G) 0.07–3.9		

Shiitake

Lentinula edodes

PROTEIN^ % 9.6–29.4	**FATS %** 2.1	**SUGARS %** 25.8
DIETARY FIBER %** 67.9	**MAGNESIUM MG/100 G** 116.5–132	**IRON MG/100 G** 20.1
POTASSIUM MG/100 G 2,647.5	**CALCIUM MG/100 G** 11–42.3	**COPPER MG/100 G** 0.9–5.2
PHOSPHORUS	**ZINC MG/100**	**THIAMIN*****

MG/100 G	G	MG/100 G
294–493	4.3–7.6	0.009–0.3
RIBOFLAVIN** MG/100 G**	**NIACIN MG/100 G**	**FOLATE (MG/100 G)*** **
0.057–1.27	2.6–14.1	25–163
VITAMIN D2* (MG/100 G)		
0.03–3.9		

Lion’s mane

Hericeum erinaceus

PROTEIN^ %	FATS %	SUGARS %
24–41.1	1–4.2	17.4
DIETARY FIBER %**	**MAGNESIUM MG/100 G**	**IRON MG/100 G**
64.8	94.8	7.7–22.5
POTASSIUM MG/100 G	**CALCIUM MG/100 G**	**COPPER MG/100 G**
2,880	16.6–17.4	0.4–1.1

PHOSPHORUS MG/100 G	ZINC MG/100 G	THIAMIN*** MG/100 G
762–1,028	1.5–12.1	0.69
RIBOFLAVIN** MG/100 G**	**NIACIN MG/100 G**	**FOLATE (MG/100 G)*****
1.89	no data	no data
VITAMIN D2* (MG/100 G)		
no data		

Maitake

Grifola frondosa

PROTEIN^ %	FATS %	SUGARS %
21.1–26.4	3.1–24.7	2.2–10.7
DIETARY FIBER %**	**MAGNESIUM MG/100 G**	**IRON MG/100 G**
68.8	65.1–145.3	18–21.4
POTASSIUM MG/100 G	**CALCIUM MG/100 G**	**COPPER MG/100 G**

2,630–3,194	248	3.9
PHOSPHORUS MG/100 G 1,028–2,691	**ZINC MG/100 G** 24.6	**THIAMIN*** MG/100 G** 0.15
RIBOFLAVIN** MG/100 G** 0.24	**NIACIN MG/100 G** 6.6	**FOLATE (MG/100 G)***** 21
VITAMIN D2* (MG/100 G) 0.08–63.2~		

Button mushroom

Agaricus bisporus

PROTEIN^ % 26–38.6	**FATS %** 2	**SUGARS %** 13.9
DIETARY FIBER %** 62.2	**MAGNESIUM MG/100 G** 91–124	**IRON MG/100 G** 5–50

POTASSIUM MG/100 G	CALCIUM MG/100 G	COPPER MG/100 G
3,500	46–99	0.52–6.7
PHOSPHORUS MG/100 G	**ZINC MG/100 G**	**THIAMIN*** MG/100 G**
969–1,730	2–12	0.012–0.19
RIBOFLAVIN** MG/100 G**	**NIACIN MG/100 G**	**FOLATE (MG/100 G)*** **
0.18–0.62	3.6	17
VITAMIN D2* (MG/100 G)		
0.07–0.23		

Cloud ear

Auricularia polytricha

PROTEIN^ %	FATS %	SUGARS %
0.9–18.3	0.5–1.7	17.6
DIETARY FIBER %**	**MAGNESIUM MG/100 G**	**IRON MG/100 G**

91.8	26–136	29.3
POTASSIUM MG/100 G 588–3,948	**CALCIUM MG/100 G** 19.6–59	**COPPER MG/100 G** 0.3–2.6
PHOSPHORUS MG/100 G 94–1,842	**ZINC MG/100 G** 1–13.2	**THIAMIN*** MG/100 G** 0.08–0.2
RIBOFLAVIN** MG/100 G** 0.2–0.9	**NIACIN MG/100 G** 0.07–1.6	**FOLATE (MG/100 G)***** 19–38
VITAMIN D2* (MG/100 G) 0.01		

Enoki

Flammulina velutipes

PROTEIN^ % 20–26.7	**FATS %** 8.9–9.2	**SUGARS %** 13.9
DIETARY	**MAGNESIUM**	**IRON MG/100 G**

FIBER** %	MG/100 G	
64.2	77.2–143	13.8
POTASSIUM MG/100 G	**CALCIUM MG/100 G**	**COPPER MG/100 G**
2,898–3,727	3.5–11	0.9
PHOSPHORUS MG/100 G	**ZINC MG/100 G**	**THIAMIN*** MG/100 G**
940–1,844	7.7–9.5	0.23
RIBOFLAVIN** MG/100 G**	**NIACIN MG/100 G**	**FOLATE (MG/100 G)*****
0.2	7	48
VITAMIN D2* (MG/100 G)		
0.04–0.4		

Chanterelle

Cantharellus spp.

PROTEIN^ %	FATS %	SUGARS %
16.2–26.3	1.9–6.8	4–9

DIETARY FIBER** %	MAGNESIUM MG/100 G	IRON MG/100 G
64.9	85–120	10–18
POTASSIUM MG/100 G	**CALCIUM MG/100 G**	**COPPER MG/100 G**
5,400–5,900	19–57	5.5
PHOSPHORUS MG/100 G	**ZINC MG/100 G**	**THIAMIN*** MG/100 G**
500–657	9–11	0.58
RIBOFLAVIN** MG/100 G**	**NIACIN MG/100 G**	**FOLATE (MG/100 G)*****
0.215	4.09	2
VITAMIN D2* (MG/100 G)		
2.18–8.41		

Porcini

Boletus edulis

PROTEIN^ %	FATS %	SUGARS %

27.2–33.1	3.6–4.5	8.3
DIETARY FIBER %**	**MAGNESIUM MG/100 G**	**IRON MG/100 G**
69.9	75–120	5–50
POTASSIUM MG/100 G	**CALCIUM MG/100 G**	**COPPER MG/100 G**
2,367–3,900	46–99	0.4
PHOSPHORUS MG/100 G	**ZINC MG/100 G**	**THIAMIN*** MG/100 G**
1,024–1,730	12	1.25
RIBOFLAVIN** MG/100 G**	**NIACIN MG/100 G**	**FOLATE (MG/100 G)*****
9.36	no data	no data
VITAMIN D2* (MG/100 G)		
35.0		

Turkey tail

Trametes versicolor

PROTEIN^ %	FATS %	SUGARS %
4.2–35	no data	no data
DIETARY FIBER %**	**MAGNESIUM MG/100 G**	**IRON MG/100 G**
65	14–87.4	3.8–47.6
POTASSIUM MG/100 G	**CALCIUM MG/100 G**	**COPPER MG/100 G**
1,989	77.1–275	1.2–32.6
PHOSPHORUS MG/100 G	**ZINC MG/100 G**	**THIAMIN*** MG/100 G**
1,007–1,123	12.3	no data
RIBOFLAVIN** MG/100 G**	**NIACIN MG/100 G**	**FOLATE (MG/100 G)*****
no data	no data	no data
VITAMIN D2* (MG/100 G)		
no data		

*Vitamin D_2 is formed in mushrooms after only 5 minutes' exposure to sunlight and is highly stable; it is just as bioavailable as the vitamin D_3 found in supplements.

**This includes insoluble and soluble branched beta-glucans, branched alpha-glucans, and chitin; these are “prebiotics” that are not digested and absorbed from the upper digestive tract but make it down mostly intact to the colon to feed beneficial bacteria. Mycelium typically has about 15% less fiber than the fruiting body.

***Vitamin B_1

****Vitamin B_2

*****µg = micrograms

~ The samples at the high end of this range had been irradiated with a high level of UV light in an effort to see how much vitamin D they could produce. Exposure to regular sunlight would not be expected to produce this amount of vitamin D.

^ Protein percentages in 25 mushroom species varied from 16% to 52% by dry weight.

Note: Values for protein, fats, sugars, fiber, magnesium, iron, potassium, calcium, copper, phosphorus, and zinc are calculated based on dry weight. The values for dried mushrooms are usually 7 to 12 times higher for the same species, compared with fresh mushrooms. Many vitamins degrade with heat and moisture loss, so values for thiamin, riboflavin, niacin, folate, and vitamin D2 are calculated based on fresh weight.

Note about data collection: This table represents a compilation of the most credible data from peer-reviewed journals. Where a range of measurements is listed, this indicates that several studies reported somewhat different statistics. Fungi in the wild or cultivated fungi vary in concentrations of nutrients depending on the substrate on which they are grown, the strain of the species, and the individual specimen being tested.

Sources: Alonso et al., 2003; Bernas et al., 2006; Daba et al., 2008; Demirbas, 2001; Furlani and Godoy, 2008; Hassan, 2007; Hung and Nhi, 2012; Keegan et al., 2013; Khan et al., 2008; Kumari et al., 2011; Liang et al., 2019; Manzi et al., 1999; Niedzielski et al., 2017; Ouzouni et al., 2009; Petrovska, 2001; Phillips et al., 2011; Ulziijargal and Mau, 2011; USDA FoodData Central Database, 2019; Wani et al., 2010; Watanabe et al., 1994.

THE HIGHEST FIBER FOOD

Not only are mushrooms high in fiber, they have *the highest dietary fiber content of any food,* on a dry-weight basis. (Most fresh mushrooms contain up to 95 percent water.) Dietary fiber comprises several types of sugar polymers — in mushrooms, this includes beta-glucans and chitin (see Fungal Beta-Glucans and Their Benefits for more about these). These polymers aren't digestible in the upper digestive tract, so they travel almost intact to the lower bowel, where bacteria degrade them as prebiotics. These support an environment where beneficial-bacteria are encouraged and potentially harmful bacteria are suppressed. In this way, when consumed regularly, mushrooms can help us maintain an optimal microbial balance for health.

Mushrooms Support Good Gut Microbes

Scientists are discovering just how important the presence of certain beneficial microbial species is for overall health, mood, immunity, and even longevity.[1] Research has shown that eating a high-fiber diet is the single most important way to prevent a range of cardiovascular-related diseases and concerns — including blood cholesterol imbalance, heart attack, stroke, and atherosclerosis (the damage to our vessels that progresses as we age, including "hardening of the arteries" due to plaque buildup) — in addition to reducing the risk of colon cancer, preventing diabetes, and simply keeping bowel movements regular.

In fact, the research shows that many of our modern health problems stem from the fact that we don't get enough fiber in our diets. People in most industrialized countries consume around 15 grams of fiber per day, whereas people in nonindustrialized countries who eat a traditional diet — one that contains almost no processed food, only moderate amounts of animal products, and lots of roots, leaves, nuts, seeds, whole fruit, grains, and beans — consume closer to 50 or 60 grams of fiber daily. Several studies have shown that people who eat that much fiber lower their risk of cardiovascular disease and cancer by one-half to three-quarters, compared to those who get only 15 grams of fiber per day. (For more details about and to get a better understanding of the benefits of mushroom fiber for health, I recommend reading the article by

Peter Cheung from the Chinese University of Hong Kong listed on here.)

> Mushrooms like shiitake contain up to 35 percent total dietary fiber, and some polypores like reishi or fu ling contain up to 85 percent.

A DAILY DIET THAT'S HIGH IN FIBER

To achieve a goal of consuming 40 to 50 grams of fiber a day, you obviously need to eat lots of vegetables, whole grains, beans, and other high-fiber foods. Mushrooms can really boost the total amount of fiber you take in. Here are some foods — including mushrooms! — that can get you up over 50 grams of fiber.

- 1 cup raw oats, soaked (museli, oatmeal) / 8 g
- 1 medium banana / 3 g
- 1 cup cooked broccoli / 3.6 g
- 3 medium shiitake mushrooms in soup or stir-fry / 7 g

1 cup cooked beans (lentils, split peas, red kidney beans, or others) / 16 g

½ cup cooked whole grains (buckwheat, brown rice, or others) / about 3 g

2–3 cups salad (with mixed vegetables: medium tomato, medium carrot, ¼ onion, lettuce) / 3 g

1 cup dark veggies (carrots, beets, collard greens) / 4 g

1 ounce nuts, seeds (small handful) / about 3 g

1 medium yam, baked / 4 g

1 medium apple or ½ cup berries / 4 g

SOLUBLE AND INSOLUBLE FIBER

When you simmer turkey tails and blend them up to dry for powder, you will see a lot of gel separate out in the water. This gel contains soluble fibers — both the valuable immune-stimulating beta-glucans and the non-starch alpha-glucans. These soluble fibers reduce inflammation in your digestive track as they pass through, reducing the risk of bowel cancer and promoting cholesterol balance.

For the full benefit of fiber, you need both soluble and insoluble fiber. Other parts of the cell wall in cooked

mushrooms, as well as the concentrated mushroom powders, are mostly insoluble fiber. The insoluble fiber can give your digestion something to work with to help remove waste products and stimulate peristalsis, helping to keep you regular. This is why it is best to consume the cooked mushrooms along with the cooking water, rather than filtering the cooked mushrooms out of the cooking water and just using the liquid as a tea.

Achieving Your Dietary Goals with Mushrooms

Because mushrooms can be consumed in a variety of preparations, they are easy to add to meals to help you achieve your dietary goals. Here are just some of the ways to get your daily dose of fungi.

POWDER. An easy way to get more fiber into your diet and reap the other nutritional and immune-boosting benefits of mushrooms is to powder them. The process of making the powder releases the beta-glucans from other polymers like chitin, much improving their water solubility and bioavailability (see Concentrated Extract Powder for more about this). You can cook mushrooms, dry them, and make a powder (see the step-by-step instructions) to sprinkle savory mushroom flavor, minerals, protein, and fiber on any food or to add to smoothies or soups. Making a tea from just one rounded teaspoon of dried, powdered mushroom, such as shiitake, adds more than 5 grams of fiber to your daily diet. Other good mushrooms for concentrated tea powder include maitake, lion's mane, and even a nonbitter species of reishi such as Ganoderma lingzhi.

STIR-FRY. Tender species like shiitake, lion's mane, and oyster mushrooms can be stir-fried. I usually add 1/4 cup of water to a tablespoon of oil in the skillet, to avoid overheating the oil and to steam-cook everything without scorching; add a bit more water later, if the mushrooms start drying out. You won't need

additional water if you're cooking fresh mushrooms that are very wet or that have been harvested during rainy weather. Always cook the mushrooms before adding any vegetables because the mushrooms often need higher heat and longer cooking. I like to add cooked lentils and a variety of herbs — including garlic, curry powder, oregano, thyme, sage, savory, and parsley — to the stir-fried mushrooms and vegetables to make a delicious soup. Stir-fried mushrooms are also perfect for adding to an omelet.

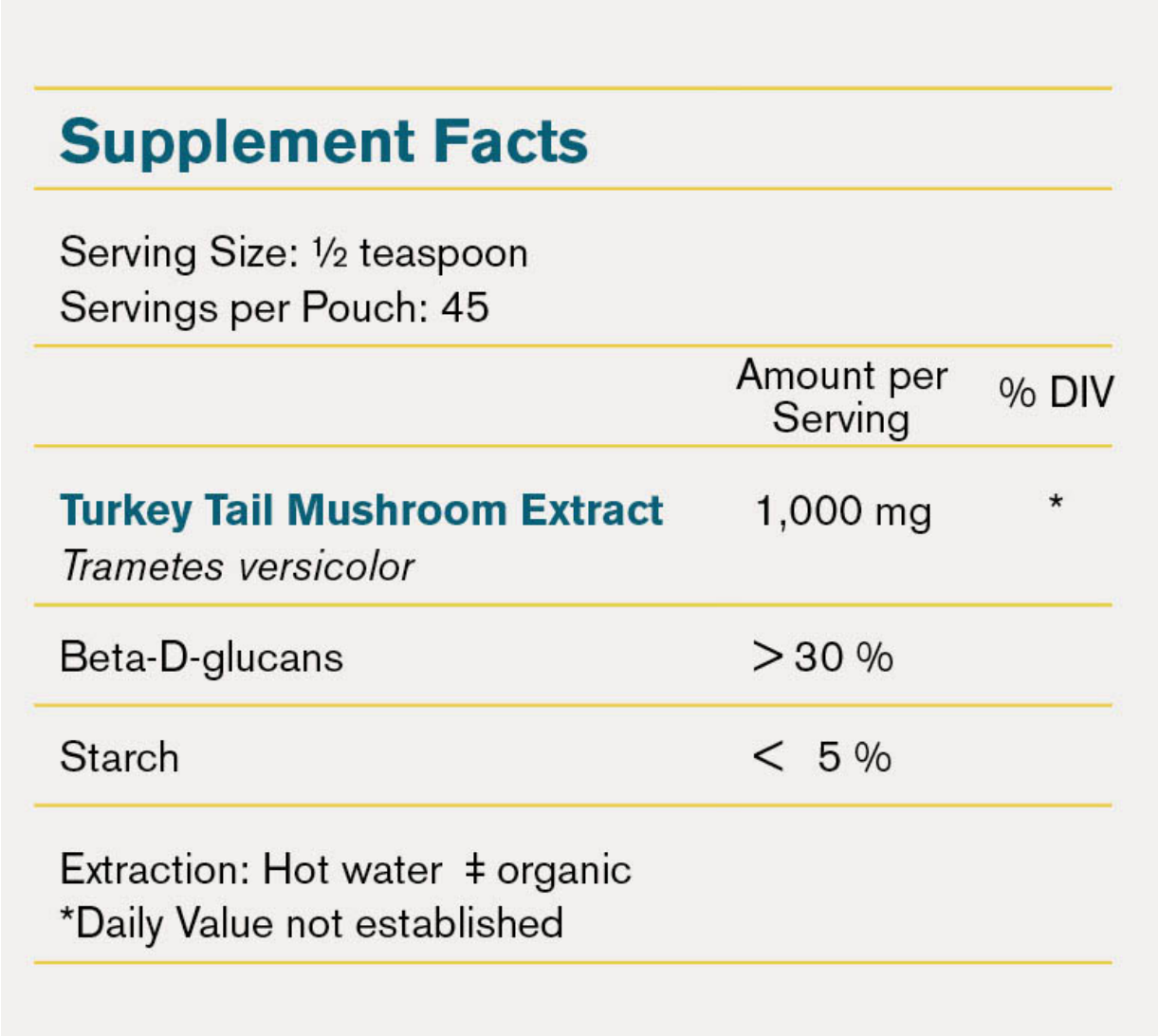
GRILL. Grilling is a good option for firm mushrooms like milky caps or members of the genus *Russula.* Brush the caps with or soak them in a sauce made from tamari, a little olive oil or toasted sesame oil, and seasonings like crushed garlic, ginger, and curry powder, then grill until tender.

PRESSURE-COOK. I often use my multicooker/pressure cooker for tenderizing polypores like turkey tails and other tough fruiting bodies. This reduces the cooking time, as well. An additional benefit is that pressure cooking increases the bioavailability of certain medicinal compounds (see Extracting under Pressure). Use the high setting on the multi-cooker for up to 60 minutes, depending on how tender the mushrooms are. Tough fruiting bodies like artist's conk need 60 minutes, but tender ones like lion's mane can be done in 30. After cooling, blend the well-cooked fruiting bodies with the cooking water. Add ¼ to ½ cup of this purée to soups for a mushroomy flavor and the benefits of the abundant fiber and immune-activating beta-glucans.

MAKE DUXELLES. This is a well-chopped mixture of mushrooms, onions, and herbs like oregano, parsley, or pepper that is sautéed in olive oil or butter until cooked. For extra protein, I add two beaten eggs once the mushrooms are cooked, then turn off the stove, cover the pan, and let the eggs set in the residual heat. You can use the more tender medicinal mushrooms — such as shiitake, maitake, oyster mushrooms, clamshells, or beech mushrooms — in this fashion.

FUNGAL BETA-GLUCANS AND THEIR BENEFITS

In addition to contributing to our overall health, some of the components that make up the fiber in fungi help modulate the immune system. These components, called immunomodulators, are found in the cell walls of all fungi. Specifically, the fiber in the cell walls of all fungi is partly composed of glucans, which are long chains of glucose molecules (and a type of polysaccharide) that are often indigestible to humans. (Starch is also a polysaccharide, but the way the glucose units are attached to one another allows our body to easily break them down and obtain glucose for energy, either utilizing it immediately or storing it as glycogen or fat.) There are two major types of glucans — alpha-glucans and beta-glucans — so-called because of how their attached glucose units are oriented.



Supplement Facts

Serving Size: ½ teaspoon
Servings per Pouch: 45

	Amount per Serving	% DIV
Turkey Tail Mushroom Extract *Trametes versicolor*	1,000 mg	*
Beta-D-glucans	> 30 %	
Starch	< 5 %	

Extraction: Hot water ‡ organic
*Daily Value not established

ABOVE: Any mushroom supplement you purchase should list the percentage of beta-glucans present in the product.

Immunomodulation

Research over the last few decades, and especially in the past 5 to 10 years, has clearly shown the significant effect fungal beta-glucans have on the immune system — for cancer treatment; to increase our resistance to viral, bacterial, and

even fungal infections; and for restoration of damaged bone marrow, where immune stem cells that can replenish and "reboot" our immune system are produced. A tremendous worldwide research effort has demonstrated that fungal beta-glucans work as an immunomodulating agent through the activation of innate immune cells such as macrophages, dendritic cells, granulocytes, and natural killer cells (see How Beta-Glucans and Chitin Activate Our Immune System). Once our immune system is activated by fungal beta-glucans, adaptive responses are triggered through key immune "effector" cells (such as CD4+ or CD8+ T cells and B cells). These patrol the blood and tissues, sense potential pathogens and waste products like dead cells, and respond by producing immunologically active chemicals such as cytokines, resulting in the inhibition of tumor growth and metastasis or destruction of pathogens like viruses and bacteria. [2]

BOLSTERING IMMUNITY AFFECTS ALL OUR SYSTEMS

One reason reishi has been known throughout history as an important medicine for calming the spirit, soothing our nervous system, and acting as a sleep aid may have to do with its complex effects on our immune system. When our immunity has been weakened by constant stress, poor sleep quality, lack of important nutrients due to poor diet, and chronic infections, this can affect our mood, energy, vitality, and ability to heal. The intimate connection between

our immune, hormonal, nervous, and digestive systems is well known.[3] The beta-glucans in medicinal mushrooms can have a profound effect on our health; they can help restore the balance and healthy functioning of our systems, fostering better sleep and a more balanced mood.

Heating to Release the Active Compounds

In order to access the active compounds in fungal cell walls, we must heat mushrooms before consuming them.

BETA-GLUCANS. Beta-glucans in the cell walls of mushrooms are tightly bound with a tough amino-glucose polymer called chitin (which is also found in crustacean and insect shells). These bonds need to be broken by high heat to make the beta--glucans more soluble and bioavailable as they pass through our digestive tract, where they interact with specialized immune tissues and are engulfed by big immune cells called macrophages.[4] Only about 20 percent of the beta-glucans are soluble without significant heating. When mushrooms or mushroom powders are heated — steamed, simmered, or boiled — some of the chitin-glucan bonds will break, making them more water soluble and bioavailable in the gut. On the other hand, when the bonds remain connected after regular cooking — for instance, giving shiitake mushrooms a quick stir-fry — they remain intact through the upper digestive tract

(where they can still interact with some immune sensors). In this form, the bonds can make it all the way to the lower intestines nearly intact, where abundant species of bacteria can break them down for food (prebiotics). The bacterial metabolic products, especially those of beneficial bacteria species, can benefit us as well; the epithelial cells that line the lower gut can utilize some of the sugars that are released as food and energy.

OTHER ACTIVE COMPONENTS. Beta-glucans are not the only type of immunologically active polymer found in the cell walls of fungi that needs to be heated to become more bioavailable. The beta-glucans are by far the most studied of the bioactive cell wall molecules, but other active compounds, such as non-starch alpha-glucans, chitin, and proteins, can also interact with our immune system and need to be heated in order to become fully available to us.

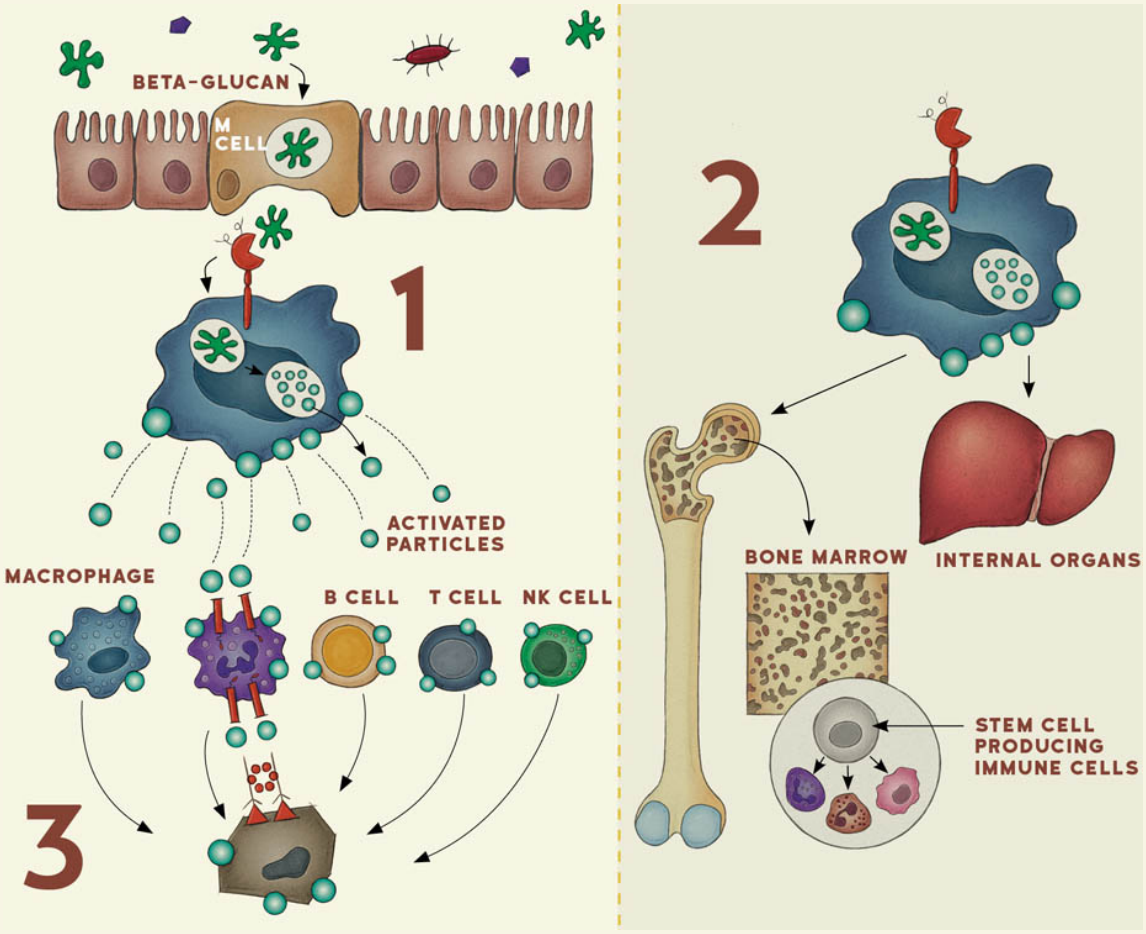
Finally, some mushrooms contain indole compounds like serotonin, melatonin, and 5-hydroxytryptamine (a precursor to melatonin), which also need heat treatment to become fully available. Chanterelles, in particular, contain a high amount of them. Mushrooms with these active compounds might be useful for counteracting sleeping problems and mood disorders (though more research on humans is needed). [5]

In some species, beta-glucans in cell walls form structures like the triple helix, adding strength and flexibility in mushrooms like turkey tail and reishi. Some research has shown that beta-glucans in the triple helix form, in addition to boosting a species' ability to penetrate tough wood, have enhanced immune-activating properties.

Beta-Glucans Vary by Species

Beta-glucans are found in all fungi, including yeasts. Some species of edible and medicinal fungi have much more of these active compounds than others do. Not surprisingly, the species of fungi that have been most revered for two to three thousand years also have the highest content of beta-glucans. These include the popular mushrooms reishi and turkey tail.

How Beta-Glucans and Chitin Activate Our Immune System



1. Beta-glucans pass through M cells in the intestinal cell wall; they are absorbed by macrophages and broken down into activated particles.

2. Macrophages are mobile, and can carry activated beta-glucan particles to tumor cells around the body,

to individual organs, and to the bone marrow, where immune stem cells are produced.

3. Activated beta-glucan particles bind to tumor cells, viruses, and bacteria, marking them for destruction by macrophages, granulocytes, T cells, natural killer (NK) cells, and the antibodies produced by B cells.

As the well-cooked mushrooms we've eaten pass through the stomach and small intestine, proteins and starches (as well as some sugars, like mannose) can be broken down, and our body absorbs some of them for energy and other benefits. Others, like the beta-glucans and chitin in the mushroom cell wall, are not digestible in the upper gastrointestinal (GI) tract because we humans do not have enzymes to break the bonds between these types of glucose molecules.

As the beta-glucans and chitin pass through the upper GI tract, they interact with the active immune cells found abundantly in immune tissue in the small intestines. An estimated 60 to 80 percent of our bodies' total lymphoid tissue is found scattered throughout the small intestine and in concentrated areas called Peyer's patches.

Special "M cells" found in the lining of the upper intestine, in regions called gut-associated lymphoid tissue (GALT), are able to take up potentially harmful bacteria and other pathogens, as well as fragments of fungal cell walls, and deliver them to active immune cells such as the macrophages in the GALT. Macrophages are

large and active immune cells that can ingest mushroom cell wall fragments, break them down, and sample the beta-glucans and chitin to determine the nature of the fungus. On their outer membrane, they have ancient recognition receptor sites, found in all animals, which allow them to connect with the beta-glucans, in some cases, “recognizing” them based on prior exposure. With recognition, our immune response can become more rapid and powerful. [6]

Once pieces of beta-glucan connect with a phagocyte through these receptor sites, they are taken up into the cell. The macrophage then starts breaking them down and modifying them. These “activated” pieces are shed by the macrophage, after which the altered pieces then have the ability to bind with tumor cells, viruses, and bacteria, to mark them for destruction by other macrophages, granulocytes, T cells, natural killer (NK) cells, and the antibodies produced by B cells. They also activate dendritic cells, which initiate an even more powerful immune response. [7]

Macrophages are mobile, and through a coordinated effort with other immune cells, the fungal beta-glucans can be actively taken to tumor tissue, internal organs, and even the bone marrow where immune stem cells are produced. (Stem cells are immune cell progenitors, and can turn into red blood cells, or various immune cells like B-lymphocytes and T-lymphocytes, and monocytes, precursors of macrophages.) Beta-glucans from fungi can help protect the bone marrow from the harmful effects of radiation and chemotherapy, as well

> as increase the production of new immune and red blood cells. [8]

The type of active beta-glucans varies from one species to the next. More than 270 recognized species of mushrooms have been studied and are known to have specific immunotherapeutic properties; these species all have different types of active beta-glucans and other compounds. [9] The beta-glucans in their cell walls have different configurations and different branching patterns. Based on these differences, the protective effects of each fungal species can be slightly different, or even widely different.

ABOVE: Turkey tails have especially high levels of beta-glucans.

BETA-GLUCAN CONTENT OF MUSHROOMS

Beta-glucans occur in every species of mushroom, providing an immune boost. Wild mushrooms in particular can have a substantial amount of beta-glucans and are worth seeking out. A recent study tested for beta-glucans in 39 edible wild mushrooms. The table below lists some of the most well-known, and certainly the most delicious, wild mushrooms and their beta-glucan content. For comparison, the four most common cultivated edibles — button mushroom, shiitake, oyster mushroom, and lion's mane — are also included.

	Beta-Glucan Content (Percentage by Dry Weight)	
Cultivated Species	**CAP**	**STALK**
Button mushroom (*Agaricus bisporus*)	8.6	12.3
Shiitake (*Lentinula edodes*)	19.8	25.3
Oyster mushroom (*Pleurotus ostreatus*)	24.2	–
Lion's mane (*Hericium*	10.0	–

erinaceus)		
Wild Species		
Chanterelle (*Cantharellus cibarius*)	23.6	26.9
Honey mushroom (*Armillaria mellea*)	33.5	38.8
Stalked puffball (*Lycoperdon perlatum*)	15.5	19.75
Slippery jack (*Suillus grevillei*)	12.9	26.8
Amethyst deceiver (*Laccaria amethystina*)*	26.3	37.4
Blewit (*Lepista nuda*)	14.6	26.8
Common yellow russula (*Russula ochroleuca*)	17.4	17.5
Turkey tail (*Trametes versicolor*)	60.8	–
Sulfur tuft (*Laetiporus suphureus*)	47.0	–
Maitake (*Grifola frondosa*)	26.0	–
Judah's ear (*Auricularia*	23.8	–

auricula-judae)		
Reishi (*Ganoderma* species)**	54.0	–
Porcini (*Boletus edulis*)	17.0	58.0

*Another related species has been described from the Pacific states, *Laccaria amethysteo-occidentalis.* This table includes the exact species used by the researchers in Sari et al., 2017. Some of the genera in the table could include other commonly collected species.

**McCleary and Draga, 2016.

Source: Sari et al., 2017.

THE ANTIOXIDANT POTENTIAL OF MUSHROOMS

Cell wall polymers like beta-glucans, some special alpha-glucans,[10] chitin, and proteins aren't the only active compounds associated with health benefits in fungi. Other active compounds in fungi that are less studied for their health benefits are smaller, low-molecular-weight compounds. The two most-studied compounds in fungi are terpenes and phenolic compounds. These are common in both plants and fungi, and a number of phenolic compounds in edible fungi have been studied for their antioxidant and anti-inflammatory properties. Much more research is needed, but fortunately,

most of the terpenes and phenolic compounds seem to have beneficial properties and low toxicity.

LION'S MANE

Hericium erinaceus

REISHI

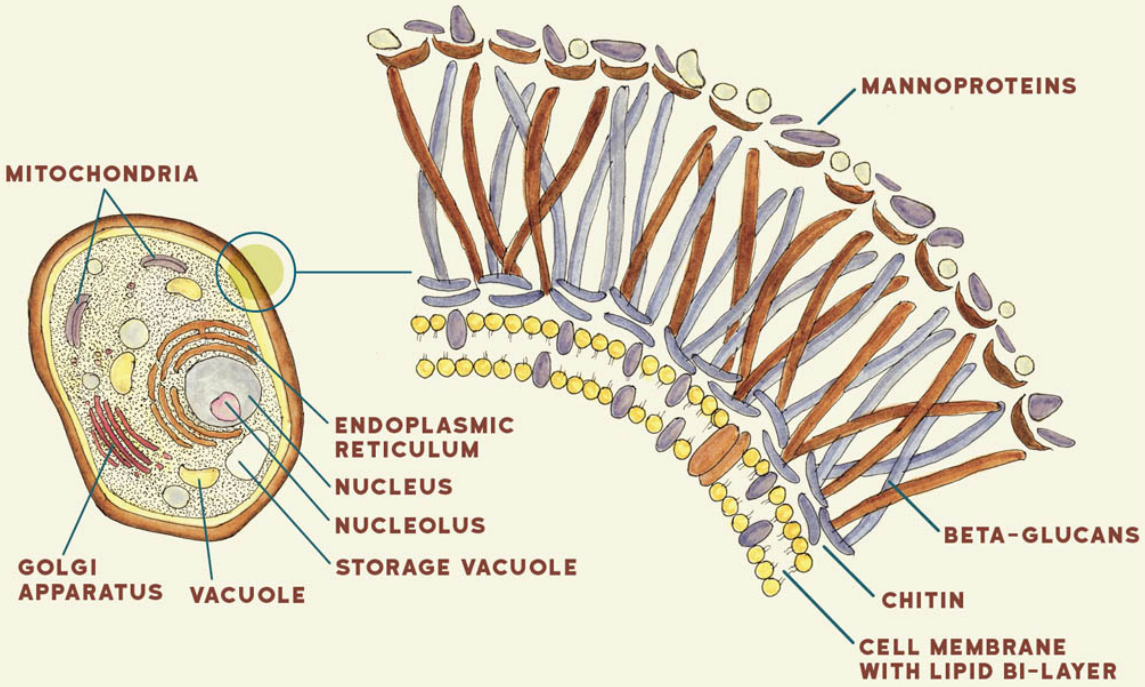
Ganoderma tsugae

SUNLIGHT BOOSTS VITAMIN D

All mushrooms contain ergosterol, a cell wall component that, when exposed to sunlight, partially converts to vitamin D2. Studies show that eating mushrooms after exposing them to sunlight 30 to 60 minutes can raise your blood serum vitamin D levels. Only the part of the fruiting body

that is exposed to light will have increased levels; slicing mushrooms before laying them out in the sun can increase the levels of vitamin D by up to 10 times. [13]

Inside the Cell Wall



MANNOPROTEINS. The outer part of the cell wall contains sugars called mannoproteins. These have projections like tiny antennae, which are used for recognition of other species — other fungi and bacteria. They identify living host tree species for mycorrhizal partnerships.

BETA-GLUCANS. The next layer comprises the interwoven beta-glucans, the most immunologically active and widely studied of all the mushroom chemical compounds. These are referred to as “beta-1,3/1,6-glucans” because of the way the glucose molecules are

attached and how they branch. They are strongly attached to chitin, which is the next layer in.

CHITIN. This is a tough polymer (also found in crab shells) made out of chains of amino-glucose molecules. They are produced in the cell wall by a compound that can be used to identify the presence of fungi in a product or infection in humans — chitinase. This compound is also immunologically active; [11] because it's an enzyme, however, it is likely damaged by high heat, so its contribution to the overall immunological effects of a mushroom product is uncertain.

CELL MEMBRANE. The membrane is a layer under the cell wall that is selectively permeable to proteins and other signaling molecules. It also contains fatty acids that may contribute to the nutritional value of fungi.

ERGOSTEROL. Ergosterol is a component of the cell membrane. The compound does have some immune-stimulating effects, and is the precursor to vitamin D2. Exposing mushrooms to sunlight converts some of the ergosterol to vitamin D2. (See Sunlight Boosts Vitamin D.) [12]

CYTOSOL. The cellular liquid inside the cell wall that contains the organelles.

ORGANELLES. The organelles include the nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus,

ribosomes, and vacuoles. As in plant and animal cells, the nucleus houses most of the cellular DNA.

LOW-MOLECULAR-WEIGHT COMPOUNDS. Terpenes, phenolic compounds, indoles, and other small-molecular-weight compounds are produced and stored in small bodies within the cytosol, such as the vacuoles.

Terpenes and Phenolic Compounds

Terpenes are a large and ancient group of hydrocarbons — compounds that contain carbon and hydrogen backbones and are found in most living things. Terpene hydrocarbons often form six-membered rings, with a set number of carbons: 10 (monoterpenes), 15 (sesquiterpenes), 20 (diterpenes), and 30 (triterpenes). For example, the essential oils found in plants like lavender, mint, and cannabis — aromatic compounds that confer anti-inflammatory, muscle-relaxing, nerve-stimulating, and antibacterial effects — are mostly made up of mono-terpenes and sesquiterpenes.

DITERPENES AND TRITERPENES. These are important and well-studied active compounds in lion's mane, reishi, and other fungi. Diterpenes in lion's mane are associated with nerve-regenerative effects (see the Lion's mane profile ofor more on these effects).

There are over 300 triterpenes in reishi-like mushrooms, many of which have been named and studied, including

ganoderic acid, ganoderenic acids, ganoderols, and lucideric acid. Significant research into these compounds shows many potentially beneficial biological activities such as anticancer, antiviral, anti-inflammatory, antioxidant, liver-protective, antiobesity, blood-sugar-regulating, and antimicrobial effects. [14]

PHENOLIC COMPOUNDS. These compounds, which include flavonoids, phenolic acids, and polyphenols like tannins, are produced in many plants and fungi and are considered protective. Some studies show they have antiaging effects. [16] Elagic acid (also found in pomegranate) and caffeic acid, which are both found in the beefsteak fungus (*Fistulina hepatica*), had a strong antioxidant and free-radical-lowering effect in laboratory studies using both human and animal cell cultures. [17]

LOOK FOR TRITERPENES ON THE LABEL

This group of compounds is highly talked about when reishi-like fungal products are considered, especially when it comes to the quality of the extract and biological activity. Companies tout the high concentrations of triterpenes in their products, sometimes even more than the beta-glucans. The amount of triterpenes in commercial products varies considerably, depending on species, how the fungi are grown, and whether mycelium or fruiting bodies are used. Depending on the species, some terpenes are higher

in the mycelium, and some are higher in the fruiting body. In reishi, for example, it's more important to know what it was grown on — whether it be cooked rice, sunflower hulls, or wood chips. [15]

Antioxidant Activity

Interestingly, the antioxidant potential in mushrooms is higher than in the most commonly eaten vegetables and fruits. Studies have shown that many phenolic compounds in mushrooms are very effective free-radical scavengers. Free radicals are known to induce oxidative damage in physiologically important molecules; reducing free-radical damage can play a key role in mitigating a number of degenerative processes related to aging, cardiovascular disease, cancer, impaired immune function, and inflammatory diseases.

Some of these phenolic compounds are well-known antioxidants — tocopherols, flavonoids, carotenoids, some glycosides, and tannins, among others. They can be found in the fruiting bodies, mycelium, and liquid cultures of fungi. Researchers have observed antioxidant properties in the compounds found in the fungi *Hymenochaete xeranticus* and *Tropicoporus linteus*. [18] An alcoholic extract of *Ramaria flava*, a common edible coral mushroom, exhibited a wide range of anticancer, antioxidant, and antibiotic activities. [19] One study found a significant amount of total phenolic compounds in a

wood-degrading fungus, *Cerrena unicolor*; an extract of the fungus had anticancer, antibacterial, and antioxidant effects. [20]

CORAL MUSHROOM
Ramaria flava

Accessing the Benefits of Terpenes

Which types of terpenes you're hoping to access determines how the mushrooms should be processed. Different types of terpenes are water soluble to varying degrees; typically, the larger and bulkier the compound, the less soluble it is in water. These are more soluble in alcohol or a mixture of alcohol and water. Monoterpenes (10-carbon terpenes, which are often volatile and have an odor) have some solubility in water and can also be accessed via alcohol. Sesquiterpenes (15-carbon

molecules) and diterpenes (20-carbon molecules) have some water solubility, especially in boiling water. Triterpenes (30-carbon molecules called sterols) tend to have low water solubility, but some can be extracted with boiling water, and even more in a pressure cooker set on high for 15 to 30 minutes. Triterpenes in the glycoside form (which means they have sugars attached to them) are an exception; they are highly water soluble.

HYDROALCOHOLIC TINCTURE. For terpenes with low water solubility, a hydroalcoholic tincture — an 80/20 mixture of ethanol and water — works well. This is suitable for extracting triterpenes from reishi or diterpenes from lion's mane, for instance. See the step-by-step for the full process.

DOUBLE-EXTRACTION TINCTURE. This combination of tincturing and hot-water extraction accesses a variety of terpenes, as well as some beta-glucans. See the step by step for the full process.

DRIED TEA EXTRACT. Since hot water alone will extract a significant amount of terpenes, phenolics, and beta-glucans, I make dried tea extract. It's less expensive to produce because it doesn't require using alcohol, and is more appropriate for children and those avoiding alcohol. See the step by step for the full process.

SUMMARY OF MEDICINAL BENEFITS

The high fiber content, substantial minerals, vitamins, fatty acids, and high-quality digestible protein count among the most important medicinal components of medicinal mushrooms, as they help prevent heart disease, diabetes, and cancer — especially when included in your regular diet. In addition to their nutritional value, mushrooms have been studied for other specific medicinal benefits, including their ability to strengthen and regulate immune functions, protect us against pathogenic viruses and bacteria, and suppress cancer cells because of their strong immunomodulating effects. One of the most exciting benefits of medicinal mushrooms is the ability of fungal beta-glucans to trigger innate and adaptive immunity to focus and energize our immune power, in order to prevent and treat infections of all kinds — viral, bacterial, parasitic, and even infections caused by other species of pathogenic fungi.

Overall Immune Support

TOP CHOICES: turkey tail, reishi

All fungi contain beta-glucans, which are helpful for supporting the immune system. Turkey tail and reishi have some of the highest amounts of beta-glucans, so if immune support is one of your goals, start with these two. For powerful

immune support, the recommended dose is at least 6 grams/day of a dried tea powder. If you'll be consuming mushrooms for immune support over the long term, switching species every three months or so may prevent your body from becoming habituated to a particular type of fungal compound (and thus lessen its response). After reishi and turkey tail, other powerful immune-stimulating mushrooms include shiitake, phellinus, split gill, fu ling, and some of the other polypores (mushrooms that have pores or tubes on the underside, rather than gills) mentioned in Other Useful Polypores.

DOES THE SITE MAKE THE MEDICINE?

Wild-harvested mushrooms naturally vary in their potency; one collection may have only a quarter of the average concentration of medicinal compounds, while another may have up to four times the average amount. Where the mushrooms grow may be one reason why.

Little research has been carried out on the potential effect a substrate might have on the medicinal constituents of fungus grown on the substrate, but more studies are certainly warranted. For example, one reason chaga is so effective is that it grows primarily on birch trees, which produce betulin — a powerful chemotherapeutic agent. And according to a famous Japanese story, people with various forms of cancer would walk a hundred miles to harvest reishi mushrooms from a particular cherry

orchard. These supposedly had the strongest medicinal activity of any reishi. It turns out that cherry trees contain amygdalin — a naturally occurring cyanogenic glycoside that has a reputation as an anticancer compound (and is also a major component of bitter almonds).

Cancer Support

TOP CHOICES: reishi, turkey tail, shiitake, chaga, split gill

For cancer support programs, start with species that have clinical trials for the strongest immune response as well as antitumor or anticancer effects: reishi, turkey tail, shiitake, chaga, and split gill. These all have high levels of beta-glucans and clinical trials showing benefits for keeping the immune response strong and for helping patients rebound after chemotherapy and radiation treatment.[21] Chaga, reishi, and turkey tail should be considered at the top of the list. Turkey tail fungi have the most clinical trials that demonstrate beneficial effects using oral doses of pure (no starch residues) mycelium extracts, called PSK (polysaccharide-K). In the best of the studies, patient volunteers with several types of cancer — cancers of the stomach and colon, in particular — who took turkey tail along with chemotherapy had significantly higher five-year survival rates and fewer side effects from the chemo, such as fatigue and nausea, compared with those who only got the chemotherapy. Shiitake, reishi, chaga, and many other mushroom extracts are likely to be helpful because of their

high levels of beta-glucans and their immune-supportive effects. All of these species should be cooked and made into tea powders as described in the step by step. Alternatively, you can purchase them as ready-made powders that have already been heat processed and finely ground.

Fungi have other classes of compounds that are known to be active against cancer cells and tumors. These include proteins, chitin, lectins, triterpenes, lipids, and phenolic compounds. Most of these work by stimulating our defenses against tumor cells, and they can act synergistically. Many fungi species, like reishi, contain a complex mixture of chemicals that activate our immune response against a variety of pathogens and cancer types. [22]

Cancer cells are wiley. They can quickly develop ways to elude our immune response. They can develop resistance to one of the most important killing mechanisms we have: the coating of tumor cells (called opsonization) with iC3b, which is a protein fragment that marks cancer cells for destruction. Fungal beta-glucans are able to override this resistance by activating natural killer cells. [23]

Other exciting research has to do with the synergistic effects of fungal beta-glucans with the use of monoclonal antibodies for treating some cancers that have been very difficult to treat, such as melanoma of the skin that has spread to internal organs and the brain. [24]

Preventing and Treating Infections

TOP CHOICES: shiitake, phellinus, agarikon, fu ling, chaga, reishi, red-belted polypore, birch polypore, agaricus

For prevention and treatment of infections, the immune response of the individual being attacked by microbial pathogens is the key, so fungi with the highest beta-glucan content are the most helpful; research shows that the chitin, mannans, phenolics, and terpenes also contribute to the overall immune-strengthening and regulating effects. Some mushrooms — such as turkey tail, oyster mushroom, agarikon, fu ling, chaga, reishi, red-belted polypore, birch polypore, and the russulas (used externally) — have direct antiviral and antibacterial effects as well.[25] Of real interest are the many studies that show that "pretreatment" with fungal beta-glucans — taking them ahead of a potential infection, to prime the immune system — can protect against bacterial, parasitic, and viral infections, such as those caused by coronaviruses and seasonal influenza.[26]

TURKEY TAIL *(left)* **SHIITAKE** *(right)*

CHAGA *(left)* **AGARICUS** *(right)*

Heart Disease Prevention and Support

TOP CHOICES: reishi, shiitake, oyster

All edible fleshy mushrooms — such as shiitake, maitake, and agaricus — can be cooked and eaten to provide fiber and antioxidant phenolic compounds, helping to slow the progression of heart disease and help heal from it as well. Shiitake and oyster mushrooms both have well-known cholesterol-regulating effects. Reishi also offers a special cardiovascular-protective activity because of its triterpenes, plus cholesterol-lowering effects, liver support, and strong

anti-inflammatory effects, as well as improving circulation.[34] It is used in traditional Chinese medicine for benefiting the cardiovascular system. According to the doctrine of signatures (the belief that the shape of a plant or plant part indicates the body part it can be used to treat), the color red is associated with the cardiovascular system as well. If you have a family history of cardiovascular disease, high cholesterol, or even diagnosed atherosclerosis, I recommend taking a teaspoon of extract powder (see the step by step) once or twice daily in water.

YEAST PRODUCTS FOR BOOSTING IMMUNITY

Even though yeasts are not mushrooms, these one-celled fungi produce beta-glucans that are similar in structure and activity to those found in macrofungi like reishi. Clinical trials supporting the benefits of fungal beta-glucans for infections use yeast cells rather than macrofungi as a source because the yeasts are easy to grow and they contain about 40 to 45 percent beta-glucans (comparable to turkey tail and reishi).[27] The beta-glucans in these studies used purified yeast extracts (*Saccharomyces* spp.) produced by harvesting yeast cells grown in huge vats, then purifying the beta-glucans from them. This dried yeast extract is sold as an immunomodulator for both humans and livestock; adding beta-glucans to animal feed reduces

the amount of antibiotics that are needed to control infections and increase productivity of meat and milk. [28]

Although yeast beta-glucan supplements are quite effective, extracts of macrofungi (like reishi and other mushrooms) do have an advantage over yeasts because they contain higher levels and more diverse low-molecular-weight compounds that are also very active against pathogens and cancer cells.

Bolstering Immunity for Athletes

In humans, yeast beta-glucans are effective for improving the immune status of athletes who have run marathons and undergone other strenuous physical activity. Immune suppression after intense athletic events has been well documented. In two connected studies by the same research group, [29] the first study (double-blind, randomized) followed 182 women and men for 28 days after running a marathon. They found that the participants who received the beta-glucan preparation had a 37 percent reduction in the number of cold and flu symptoms compared with those who received a placebo preparation. In the second study, 60 men and women were given a placebo or beta-glucan preparation (250 mg/day). Saliva was collected 2 hours after 50 minutes of strenuous bike riding and tested for IgA antibody, crucial for destroying invading pathogens associated with the mucous membranes. The group that received the beta-glucan preparation had 32 percent higher levels of IgA antibody

than the placebo group. Previous studies show that a reduction in IgA after strenuous activity is associated with increased symptomatic days during respiratory tract infections. [30]

Yeast Beta-Glucans for Respiratory Tract Infections

In another randomized, double-blind study with 162 healthy participants, the group that received 900 mg/day of yeast beta-glucan had 25 percent fewer diagnosed respiratory tract infections (common colds) than those receiving the same amount of a placebo. [31]

In a third study, 45 older volunteers received either 250 mg once daily of a placebo or a yeast beta-glucan product for 90 days. Those in the groups who received the beta-glucan preparation had 24 percent fewer confirmed respiratory tract infections than in the placebo group, and improvements in levels of gamma interferon, an important signaling molecule that helps orchestrate our immune response to viral or bacterial infections. [32] Gamma-interferon levels are known to decline during respiratory tract infections. Finally, a double-blind, randomized placebo-controlled study that included 299 healthy men and women took either 900 mg fungal beta-glucans or a placebo preparation for 16 weeks. [33] Close to the same number of participants (70, 71) in both groups experienced a clinically diagnosed upper respiratory tract infection. The severity of symptoms was significantly lower and the

overall positive mood was higher in the participants receiving fungal beta-glucans.

Of interest in this study was the fact that the adverse events reported were only minor in the fungal beta-glucans group, other than those related to upper respiratory tract infections — abdominal bloating, diarrhea, and nausea. One report came from a person taking the placebo, and four from the group receiving the fungal beta-glucans. The tolerability reported by the participants was "good," with only seven receiving the placebo and six receiving fungal beta-glucans rating the tolerability "slightly unpleasant." This amounts to slightly over 4 percent.

Cognition, Mind and Memory Support

TOP CHOICES: lion's mane, reishi

Lion's mane and reishi are two of the most-researched species for cognitive support. Over the last eight years, five separate research groups found that a regular supplement of lion's mane extracts improved age-related recognition memory in aging mice after two months. Many studies on lion's mane for memory benefits include both the mycelium and the fruiting bodies (in a ratio of 4:1). The most recent study identified-positive effects of lion's mane powder on neurogenesis (promotion of new nerve growth) in frail and memory--

challenged mice. (See here for more about the compounds responsible for these effects.)[35] Red reishi tea powder can be taken daily (2 grams/day or ½ teaspoon/day) in a little water or tea for strengthening the memory, according to its long-standing use in traditional Chinese medicine.

Lifting Mood and Boosting Energy

TOP CHOICES: reishi, cordyceps, lion's mane

Direct communication between our brain and immune system is well studied, and many studies show that mood, energy, and other body functions are directly affected by how well the immune system functions.[36] So it makes sense that any species of mushroom with immunomodulating effects, taken regularly, can help improve energy and mood — especially if your immune system is not functioning optimally because of stress and poor nutrition. Studies show that fungal beta-glucans by themselves can support a good mood.[37]

In traditional Chinese medicine and Western herbalism, some species in particular have been known to positively affect mood, psychology, energy, and physical performance. Foremost among them is reishi. Since ancient times, traditional Chinese medicine has indicated reishi to enhance mood and energy. In the Bencao Gangmu (the most revered compendium of Chinese herbal medicine, dating to ancient times), it is called a "spirit" or "divine" medicine and was said to make one "happy and vigorous" with long-term use. I have noticed this effect myself after taking ½ teaspoon of the dried

tea extract twice daily on and off for several years. I frequently prescribed reishi for mood swings and disorders in my clinic, with positive results.

Regular use of cordyceps for enhanced energy, sexual potency, and increased physical performance was noted by ancient practitioners in Chinese medicine and is still popular for these same goals. For maximum benefits, use only products containing *Cordyceps militaris*.

This is the closest species to *Ophiocordyceps sinensis* available in legitimate commercial products in the United States. Just a few clinical trials are accessible and published in English, but animal studies with *C. militaris* and *O. sinensis* consistently show increases of energy and vitality with a hot-water extract of mycelium. [38] Refer to the section on cordyceps for more details (see here).

Throughout China (and increasingly in other countries as well), a daily supplement of lion's mane is widely regarded as helpful for promoting good health, energy, and mood. One clinical trial found that 30 women diagnosed with depression and anxiety had much improved symptoms when taking lion's mane compared with those receiving a placebo pill. [39]

Promoting Sleep

TOP CHOICE: reishi

For promoting sound sleep and addressing chronic sleeping problems, reishi products that include a standardized amount of triterpenes are the best. Products with a guaranteed amount

of beta-glucans are more reliable; when products have at least 10 percent, they are more likely to have the triterpenes as well. Over many years of consulting at my clinic, I saw patients benefit from the calming, centering, and sleep-promoting effects of red reishi, especially with long-term use. I have experienced it myself. I regularly recommend 1 to 2 grams/day of the extract powder, up to 1 teaspoon/day, as needed. You should feel some benefits within a couple of days, and this can increase over time.

DRIED LION'S MAIN

Sexual Vitality

TOP CHOICES: cordyceps

Cordyceps is the only medicinal mushroom that has a long history of use for sexual potency and vitality. Based on the DNA

evaluations I've performed on a number of products made in the United States, I recommend using *Cordyceps militaris*.[40] It is related to wild cordyceps, has similar chemistry and biological activity, and is a reliable ingredient in US products. *Ophiocordyceps sinensis* (wild cordyceps, with the caterpillar) may or may not be more effective, but it is fantastically expensive and generally not available in commercial products in the United States. Most commercial products in the States are made from mycelium; pure fruiting body products are available, but are more costly. For patients with a decreased sex drive, I recommend consuming ½ to 1 teaspoon of powder in a little water or tea, once or twice daily.

CORDYCEPS

Weight Management

TOP CHOICES: oyster, shiitake, fu ling

Oyster mushroom is excellent for supporting a weight-loss program, as is fu ling. Shiitake and oyster mushroom powder or fruiting bodies, taken daily, can also be helpful. The fiber

makes you feel full and reduces appetite somewhat; high fiber intake before mealtimes can also retard the absorption of carbohydrates and fats.

OYSTER

Nerve Support

TOP CHOICES: lion's mane, reishi, honey mushroom

Lion's mane has the best evidence and is widely known for nerve health and repair. A significant number of laboratory and animal studies show that the compounds in lion's mane can stimulate the release of nerve growth factor to promote repair and reduction of nerve inflammation. See the Lion's Mane section for more details. In China, lion's mane fruiting bodies are widely cultivated and sold in grocery stores for addition to soups and other dishes. Numerous supplements in powder form, as well as capsules, are also available and tremendously popular. I value reishi as a frequent supplement for mood disorders and as a tonic supplement for nervous system and psychiatric disorders. This is how it is used in China as well.[41] Honey mushroom extract is noted in traditional Chinese medicine for epilepsy, spasms, tics, and even seizures.

LONG-TERM USE AND HABITUATION

Research to date has not settled the question about whether long-term use of fungal products can lead to "habituation" — the immune system adjusting to exposure to a set of particular beta-glucans from one species of fungi, like reishi.[45] For example, commercially produced rainbow trout that were given a supplement of yeast beta-glucans experienced enhanced immunity for up to 46 days, leading to a reduced need for antibiotics.[46] Some studies in humans show that long-term use can lead to reduced

immune-stimulating effects, while others — such as clinical trials with turkey tail beta-glucan supplements like PSK (see Cancer Treatment and Prevention) — have found favorable effects even when the supplement is used for years. [47]

Kidney Support

TOP CHOICES: cordyceps, reishi

Several clinical trials have shown that a strong dose of *Cordyceps militaris* — ½ teaspoon of the extract powder, twice daily — on a regular basis has protective effects against agents that may be harmful to the kidney, including long-term use of many pharmaceutical drugs, such as pain relievers. Cordyceps has been an important kidney remedy in traditional Chinese medicine for the last two thousand years. Reishi also has kidney and liver-protecting effects and is worth adding. Consuming ½ to 1 teaspoon of the extract powder twice daily is best.

Liver Support

TOP CHOICES: reishi, shiitake

Reishi is well known to have liver-protective effects; shiitake, maitake, and oyster mushrooms are also useful. [42] Our liver has so many important tasks, including detoxifying our blood

and entire body. It also regulates hormone levels, produces immune substances such as immunoglobulins, and stores vitamins and glycogen for quick energy. Reishi is thought to activate the "liver channel," meaning that it helps increase bile flow and the liver's regulatory functions. The liver is believed to be largely responsible for regulating the emotions and keeping our internal processes in harmony in traditional systems of medicine; in traditional Chinese medicine the liver is associated with irritability and anger, as well as emotional instability in general. Using reishi as well as other liver support herbs like milk thistle and schisandra can help alleviate these imbalances. Laboratory studies show that reishi can protect the liver against harmful chemicals. [43]

Digestive Support

TOP CHOICE: fu ling

Fu ling is widely known and prescribed for digestive problems by practitioners of traditional Chinese medicine. It is often combined with other herbs to counteract weak digestion — that is, not being able to break down and assimilate nutrients, loss of weight, and low energy, especially associated with watery stools or water retention. The recommended dose is 6 to 15 grams/day as a tea, or 3 to 6 grams/day of an extract. It is often used together with other digestive tonics such as ginger, ginseng, and licorice. [44]

SPECIES TO START WITH

If you have a specific condition you'd like to treat, such as a viral infection, or if you're concerned about potentially having a negative reaction to medicinal mushrooms, I recommend starting with just one species — two at most. Then, in the rare instance you experience a side effect like upset stomach, you can identify the species you're reacting to and try a different one.

Turkey tails, reishi, and shiitake have the longest and most revered history of use in traditional medicine, as well as the most extensive supporting research. I recommend starting with turkey tail, which offers a high level of beta-glucans, as well as reishi because of its multiple benefits for the nervous, cardiovascular, and immune systems, as well as benefits related to mood and liver health. Shiitake has positive clinical trials and a significant amount of laboratory research to support its use for immune-strengthening to help the body fight infections, as an important part of a cancer support program, for liver support, and for balancing cholesterol. If you're generally healthy and you want to stay healthy, and you're using mushrooms as a daily supplement, I recommend using a combination of species. Blended products on the market contain anywhere from 5 to 14 species or more.

BE WARY OF "MIRACLE CURES"

In my experience, medicinal fungi can be powerful allies when used as part of a total program for health. Because medicinal fungi are so safe, they are well worth adding to any healing program; they are extremely helpful for increasing and activating the immune response against pathogens, perhaps even fighting cancer, as well as relieving the side effects of conventional cancer treatments such as chemotherapy. I have recommended them to my patients and used them myself for over 30 years.

However, considering all the many factors outside of our control that influence our health and the progression of disease, it's unwise to think of *any* remedy as a magic bullet. Taking a variety of different treatments, undergoing counseling, and following new health habits create a series of complex interactions that would be difficult for any single therapy to address completely. Cancer, for example, is a set of complex metabolic diseases, and the response by our immune system to any disease is equally complex. This is something to keep in mind when considering the advertising claims of commercial products.

Diversify Your Supplements

Medicinal mushrooms can be consumed regularly for a very long time — up to two years or more. Although there is no clinical research to support the idea that the immune system "habituates" or adjusts to mushrooms (thereby reducing their

efficacy), common sense dictates that it could be beneficial to switch species every few months so the body is exposed to beta-glucans with varying stuctures — especially if the original supplement appers to be less effective over time. For example, if you use turkey tails or reishi, switch to shiitake, maitake, chaga, lion's mane, agaricus, or phellinus because they offer different immunologically active compounds, such as structurally different beta-glucans, that could affect your immune response in different ways.

After extended use of a single species like turkey tail for six to eight weeks, I recommend patients stop taking a product for one or two weeks and note any differences. Do you generally feel better or worse? Do you have more or less energy? Your observations can help evaluate the benefits of a species. Then add in a different species and observe how you feel. This is my recommendation for the vast majority of dietary supplements in the marketplace. In my clinic, I sometimes observed that people kept taking a particular supplement for years just because they were used to taking it. When I asked them to stop for a couple of weeks, they reported feeling no difference, except to their pocketbook. During times of extra stress or if you are coming down with a cold or flu, try reintroducing one of the mushrooms regularly, based on your previous experience with a particular species.

ABOVE: Turkey tail is a good species to start with because of its multiple health benefits and because it's relatively easy to identify in the wild.

2

MAKING MUSHROOM MEDICINE

Making your own medicinal mushroom products is the best way to have a steady, cost-effective, high-quality supply of mushroom medicine. You can grow or forage your own, but fresh or dried mushrooms are readily available at many grocery stores, and dried mushrooms can be purchased in bulk online. Mushroom medicinal products are easy to make and can be delicious, too.

ACQUIRING MUSHROOMS

Now that you've learned about how mushrooms support health and healing, the next step would be to obtain some to try. Familiar edible mushrooms are available fresh in most grocery stores, as are wild species, in some cases. Whole dried fruiting bodies such as reishi, lion's mane, maitake, and shiitake can be purchased in bulk. You could even try foraging or growing your own.

Selecting Fresh from the Store

Many supermarkets, natural foods stores, and even farmers' markets have a basic complement of edible mushrooms. Almost every store that carries produce has the button mushroom and its other varieties, crimini and portabello. Many stores stock fresh shiitake mushrooms, and some carry maitake and oyster mushrooms. You'll often find dehydrated mushrooms there, too. If you live in a progressive city, you can easily locate markets that carry local wild mushrooms in season — such as porcini, chanterelles, black trumpets, hedgehogs, and wood ears — along with the lesser-known pioppini, beech mushroom (a.k.a. clamshell mushroom), enoki, and lion's mane.

Always select ones that look fresh, with no obvious signs of degradation. Many fresh mushrooms start darkening, dissolving, fermenting, and degrading within days if they aren't properly refrigerated.

Buying Dried Mushrooms in Bulk

Keep in mind that appearance doesn't matter when you're purchasing dried mushrooms for making medicine, as long as they are not black or look like they were rotten before they were dried. Appearance features like cracking, broken pieces, and some surface discoloration do not matter because you are going to cook and blend them up. To save money, buy bags of

dried mushrooms that aren't perfect; they may even be in pieces. I've purchased dried organic shiitake mushrooms this way, and they not only worked fine but were half the price of perfect, whole fruiting bodies.

Many types of dried medicinal mushrooms can be purchased inexpensively at a Chinese grocery or herb shop, though the quality, purity, and freshness from these sources can rarely be confirmed. Most are not organically grown and could contain

heavy metals such as arsenic, nickel, and cadmium. Some research papers report levels in mushrooms that exceeded allowable levels and could pose some risk to consumers.[1] For now, I recommend buying bulk mushrooms from domestic sources that follow organic practices, with few exceptions (see Resources).

WINE-COLORED AGARICUS

Agaricus subrutilescens

HOW TO STORE MUSHROOMS

There are a number of different ways to store mushrooms.

SHORT-TERM STORAGE. Fresh mushrooms can be stored in wax-paper bags or glass containers in the refrigerator for a few days, and sometimes up to a week (depending on the species).

FREEZING TO KILL LARVAE. Some fruiting bodies may contain insect larvae or eggs from fly species, which can hatch and emerge during storage. I've seen this happen with freshly picked turkey tail and reishi that were dried immediately, and even with store-bought fruiting bodies that seemed completely dry. On one occasion, I bought a dried reishi from a Chinese herb shop that was hard and looked varnished and very nice; a month or two later, I picked it up to find that the bottom half had been completely eaten by larvae and only a powder remained. It looked very sad.

To prevent this, dehydrated mushrooms purchased in bulk, which will be stored before processing further, should be frozen for at least three days. After being frozen, they can be stored indefinitely in sealed canning jars, away from heat and light.

> Dried mushrooms should be frozen for at least three days before being stored long term.

DEHYDRATING FOR LONG-TERM STORAGE. Drying mushrooms, then freezing them for up to a week (to kill

any larvae), and storing them in glass jars in a cool, dry, dark place is an excellent way to preserve them. Beta-glucans are incredibly stable, so as long as you're storing dried mushrooms properly, the beta-glucans will last for two or three years. The diterpenes and triterpenes in lion's mane and reishi are also quite stable.

Meaty mushrooms like porcini should be sliced thinly, then dried in a food dehydrator until they're so dry that you can snap a piece off. Thin, fleshy, fibrous mushrooms such as turkey tail do not need to be sliced; they can simply be spread out on dehydrator trays and dried. When the porcini fruit up in the Rocky Mountains and I'm harvesting a bounty, I sometimes have two dryers full of sliced mushrooms going at once. The aroma is heavenly!

MUSHROOM POWDER EXTRACT. Mushrooms can be cooked, blended, dried, and then ground into powders to access the most beta-glucans possible (see the step by step). Like dehydrated mushrooms, powders should be stored in glass jars in a cool, dry, dark place.

Foraging and Growing

If you like wandering through the woods or even just through a wooded neighborhood, I recommend learning to identify a few wild medicinal species to harvest. The best ones to start with are the polypores because it is unlikely you would ever run

across a toxic one. (The one exception in the eastern United States, and sometimes in the Southwest, is *Hapalopilus rutilans*. See Other Useful Polypores.) Start with turkey tail, reishi-like mushrooms, artist's conk, or just about any woody conk you find on dead trees or logs. The best places to look in any woodsy area are in wet spots, such as along the side of a creek, even if it is seasonal. See Foraging for Mushrooms for more information.

If you live in a city with few trees, another option is to grow your own mushrooms from a log or block that is already inoculated with mycelium. These are increasingly available at local grocery stores or from online retailers (see Resources).

WAYS TO EXTRACT AND ACTIVATE MEDICINAL COMPOUNDS

Heating is the primary way to unleash the full medicinal benefits of mushrooms. The beta-glucans and other cell wall components are sturdy and need to be cooked before they can become bioavailable. Breaking open the tough cell wall releases useful low-molecular-weight compounds such as diterpenes and triterpenes, so they can be absorbed by our body. Minerals become more bioavailable when mushrooms are cooked. Heating also reduces the potential irritating effects of fiber during digestion.

The downside is that a lot of boiling (and exposure to alcohol) will reduce the amount of some of the B-complex vitamins. Thiamin is sensitive to heat, as is pantothenic acid. Fortunately, vitamins B_6, B_{12}, and riboflavin are not very heat sensitive. The smaller diterpenes and triterpenes and other active compounds inside the fungi cell wall are somewhat heat sensitive. If you are particularly trying to capture diterpenes or triterpenes, a double-extraction tincture (which uses both heat and alcohol; see the step by step) is an option.

Alcohol is a great solvent for extracting and preserving the low-molecular-weight compounds such as the diterpenes in lion's mane and the triterpenes in reishi. These compounds are also soluble in hot water; for centuries, reishi has been simmered in order to capture all of its beneficial activity. Because beta-glucans have virtually no solubility in alcohol, and because most of the medicinal compounds are heat stable, simmering or pressure cooking is the best way to access the full medicinal potential of mushrooms.

STEP BY STEP:
DECOCTION

Making a decoction, or simmered tea, simply involves boiling mushrooms for an extended period of time. In traditional Chinese medicine, the mushrooms and herbs in a prescription are often boiled for an hour.

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1. Weigh the dried or fresh fruiting bodies, then cut them into pieces. I use garden clippers to cut reishi or other hard fruiting bodies into small pieces or strips.

2. Blend the mushrooms with 10 times the amount of water (weight to volume). For example, use 5 ounces of fruiting bodies by weight and 50 ounces of water by volume.

3. Pour the mixture into a pot. Bring the water to a boil and reduce the heat to a vigorous simmer for an hour with the cover off. Continue to simmer until the water has been reduced by at least half.

4. Strain the liquid through a fine-mesh sieve and and press the marc (spent mushrooms) to extract as much liquid as possible. For an even more potent tea, strain the mushrooms, put them back in the pot, and add about half the amount of water as in the first boiling. Cook the mushrooms for 40 minutes. The dark color and the smell of the water indicate that there are still active compounds to extract. Strain the mushrooms and combine the two decoctions. Add honey to taste. Drink ¼ cup at a time, up

to ½ cup, once or twice daily, depending on your need. Half a cup per day day is usually fine for maintaining health. If you are dealing with a chronic or acute condition, you can double the dose.

VARIATION:

Stabilizing a Decoction

If you want to make a shelf-stable concentrated liquid tea, follow the instructions above, being sure to cook the mushrooms twice, as described in step 4, and to combine the decoctions for increased potency. Then stir in ¼ teaspoon of vitamin C powder for each liquid ounce of tea. Acidifying the decoction will prevent bacteria or yeast from fermenting it. It can last up to several weeks at room temperature, or several months in the refrigerator, depending on the species of fungus being used. (Some, like chaga, can inhibit the growth of bacteria and other fungi. Others, like oyster mushrooms or shiitakes, don't contain as many antimicrobial compounds.) To make the decoction last longer (and increase the bioavailability of the triterpenes and other compounds in the mushroom), add 25 percent 180 or 190 proof ethanol by volume, or a tincture of the marc after cooking. This is how a double extraction is done (see the step by step).

ADDING HERBS DURING DECOCTION

You can add other herbs when you're simmering the mushrooms, to enhance the therapeutic quality you're hoping to receive from a particular mushroom, or to improve the flavor. For example, reishi is quite bitter;

adding 10 to 20 percent flavorful herbs, such as licorice slices or dried ginger, makes it more palatable.

For an extra immune boost, add astragalus root. For stress relief, eleuthero, ashwagandha, rhodiola, and other adaptogens are good choices. For cardiovascular benefits, try hawthorn leaf, flowers, or fruit. For better sleep, add ashwagandha or kava. For energy, use ginseng. To make the mushroom tea extract spicier, add ginger (fresh or dried will work). For sweetness, add licorice, jujube (red Chinese date), goji berries, or stevia. For flavor, add orange peel.

It's better to simmer herbal roots, barks, or fruit than leafy herbs like peppermint because the active oils and other delicate compounds in aromatic herbs are likely to dissipate during cooking. However, hydrosols — herbal waters made by distilling aromatic herbs like orange peel, lavender, or rosemary — are an effective way to capture an herb's essential oils. These can be sprayed on the dried mushroom wafers in the dehydrator, then allowed to dry with just the dehydrator's fan running (no heat) until the moisture evaporates.

EXTRACTING UNDER PRESSURE

An exciting and fairly new method of extracting a wide variety of active compounds from herbs and fungi is called "subcritical water extraction." Water in a subcritical state is simply water that is heated to its boiling point or higher at a pressure greater than one level of atmosphere (normal pressure at sea level) — in a pressure cooker, for example. Research shows that the higher the pressure and temperature inside the pot, the better solvent it becomes for active compounds like triterpenes and beta-glucans, because the molecules are less tightly bound to each other. If you have an espresso machine, you've used the principles of subcritical water extraction. Espresso machines operate at 195 to 205°F

(90 to 96°C) and 130 psi of pressure. At this temperature and amount of pressure, more caffeine is extracted in a shorter time than with other brewing methods, such as percolation.

Subcritical water extraction has additional benefits on a commercial scale. Since only water is used, rather than methanol or ethanol, this is a very clean, environmentally friendly, and sustainable way of completely extracting medicinal compounds, even from the toughest mushroom or herb material. Subcritical water extraction is also 50 to 100 percent more effective than alcohol at extracting many constituents that are usually not soluble in water. [1]

Although much of the current research uses equipment that can reach higher temperatures and levels of pressure than are achievable with a regular pressure cooker, home herbalists can still improve the efficacy of their medicinal products by cooking mushrooms under pressure rather than simply simmering them. Tough mushrooms like reishi should be cooked for 60 minutes in a multicooker set on high. More tender mushrooms, such as lion's mane, can be cooked for 20 to 30 minutes on high. [2]

ABOVE: Cooking tough, fibrous fungi like reishi under pressure releases more beta-glucans than simply boiling.

CONCENTRATED EXTRACT POWDER

The key to getting the most medicinal value out of mushrooms is to blend the entire cooked fruiting body along with the liquid it was simmered in, rather than simply make a strong tea and discard the mushroom material. By consuming the cooked fruiting body and the cooking water, you receive all the benefits of the beta-glucans in the cell walls, along with the low-molecular-weight compounds in the liquid.

To capture all these medicinal elements in a highly assimilable dried form with a long shelf life (up to three years), make a concentrated tea extract. This is a powder made by brewing a strong tea from the mushrooms, concentrating it by evaporating 50 to 80 percent of the liquid, then blending the cooked fruiting body with the liquid until creamy, and finally drying the slurry in a food dehydrator to create "mushroom leather," which is powdered in a blender or coffee grinder. The resulting powder has a 2:1 extraction ratio; 1 ounce of your finished tea powder has all the activity of 2 ounces of the original mushroom. In some cases, 1 gram of the finished powder is equivalent to 5 or even 10 grams of the original fruiting body, depending on how much carrier you add to the extract (see Using a Carrier to Reduce Grittiness for more on carriers) or if you choose to reduce the amount of fruiting body.

DRIED SHIITAKE

Benefits of Powdered Extract

One advantage to powdering mushroom material is that it increases the amount of surface area that comes in contact with the lymphatic tissue in your gut, where microparticles of mushroom are engulfed by macrophages and are shuttled inside the body as they travel through your digestive tract.

It can be expensive to purchase mushroom products in capsule form for daily use — for example, when treating a chronic ailment. Making your own tea concentrate or purchasing heat-treated powders is a good alternative to purchasing capsules. In my experience working with patients who have chronic ailments, it's also much easier and more palatable to add a teaspoon (3 to 4 grams) of mushroom powder to warm water or herbal tea and drink it, or add it to a soup, than it is to swallow handfuls of capsules. A concentrated tea made with enough raw materials (dried or fresh mushrooms), or a heat-treated mushroom powder with 10 to 30 percent beta-glucans is as potent, or more potent than, what is typically found in capsules.

ABOVE: A teaspoon of shiitake dried tea powder can contain up to 200 mg of total minerals — including essential minerals such as potassium, iron, and copper — and about 750 mg of beta-glucans.

STEP BY STEP:
CONCENTRATED EXTRACT POWDER

1. Rinse the fruiting bodies and pull off any bark, moss, or other debris. Cut them into small pieces, using a knife or garden clippers, if necessary.

2. Put the mushrooms in a big pot with about 10 times as much water as mushrooms and simmer for 2 to 3 hours. Alternatively, cover the cut mushrooms with an inch or two of water and cook them in a multicooker on high pressure

for about 45 minutes, with the keep-warm function turned off.

3. After the mushroom mixture cools, pour it into a blender and blend it to a creamy texture.

4. Pour the resulting “batter” onto lightly oiled fruit leather trays of a dehydrator, and dry at 95°F/35°C until all the moisture is gone. Alternatively, pour it onto lightly oiled baking sheets and dry in the oven, with the door slightly ajar, at the lowest heat setting. Keep in mind that higher temperatures can toast or darken the extract, which degrades some constituents.

5. Pull or scrape the dried wafers off the trays or sheets and break them up into pieces.

6. In a blender or an electric coffee grinder, process the pieces into a fine powder. These powders will still be in good shape after 2 to 3 years if stored in an airtight glass jar away from heat and light.

USAGE. Use ½ to 1 level teaspoon (2 to 4 grams) one to three times daily, depending on your needs. For maintenance to tonify your immune response, or to prevent colds or flu, use ½ teaspoon twice daily. Patients with greater need, such as during a chronic illness, may take 1 level teaspoon two to three times daily.

Many of the most widely used mushroom species are not bad tasting, just rather bland — except some species of reishi, which can be quite bitter. Adding the extract to a flavorful herbal tea (like ginger, especially in winter) makes it more palatable. Stir the powder into the tea, then drink it along with any residue at the bottom. Or just mix it in water. The powder can also be sprinkled into soups and on other foods for a mild mushroom flavor and an immune boost.

VARIATION:

Using a Carrier to Reduce Grittiness

If you prefer to make a mushroom powder that will completely dissolve in warm water so that you can make an instant tea without particles in it, you'll need to use a carrier such as cornstarch, arrowroot starch, maltodextrin, or food-grade cellulose (all of which are available online). This method is best suited either for people who don't like the grittiness of the mushroom fiber in the instant tea or for

those who use it for general health benefits and maintenance. The trade-off is that you won't receive the full benefits of consuming the entire fruiting body and its beta-glucans. If you are dealing with a chronic illness or wish to reduce symptoms, you'll want to consume all of the mushroom in the extract.

After step 2, strain out the cooked mushroom, measure the liquid, then simmer it until it's reduced to about one-tenth of the original volume, about 2 hours. Cool the liquid, then add the carrier, stirring in a little at a time and waiting until it is absorbed before adding more. Add enough to make a fairly thick consistency — rather like a smoothie — then proceed with dehydrating (see step 4).

The carrier absorbs the mushroom tea concentrate and thickens it so that you can powder it easily when it's fully dehydrated. If you were to simply simmer the mushrooms, strain them out, simmer the concentrate until it's very thick, then try to dry it, the resulting residue would not only be very concentrated (making it harder to measure the right dose), the yield would be incredibly low. In addition, the tea concentrates of certain mushrooms have gels in them, which make powdering difficult because it is too gummy.

BASIC TINCTURES

There are good reasons to make tinctures from mushrooms. Tinctures are handy to carry and have a long shelf life. And

because tincturing is a cold-extraction process, it captures somewhat more of the low-molecular-weight active molecules — diterpenes, triterpenes, and phenolic compounds such as antioxidants. So, for example, if your goal is to make a portable, shelf-stable product that captures the diterpenes in lion's mane for nervous system and mood benefits, or the triterpenes in reishi to support the respiratory tract and nervous system, a tincture or double-extraction tincture is a good option. Because it doesn't involve heat, though, basic tincturing does not maximize extraction of beta-glucans.

STEP BY STEP:
A BASIC TINCTURE

1. Cut fresh fruiting bodies into small pieces. If the mushrooms are dried, soak them in water in a large bowl for an hour or two to rehydrate, then cut them. (When mushrooms are dried, the cells contract and the alcohol used in step 2 will not completely relax them. Unless they're rehydrated, the constituents won't be able to freely move out into the liquid.)

2. Drain off all the water, if using dried mushrooms. Put the mushrooms in a blender, and add enough high-proof alcohol (190 proof is best) to cover the mushrooms.

3. Blend the mushrooms into the alcohol, then pour the mixture into a jar.

4. After the mushroom mass settles, add enough additional alcohol to cover the mushrooms by up to 1 inch. To speed extraction, shake the jar daily for about 10 days. (Leaving it longer won't hurt the process.)

5. Strain off and squeeze the marc (spent mushrooms) to capture all the fluid, then bottle the tincture. The tincture should have a stong taste and a reddish or yellow cast. If kept away from heat and light, it will last for up to 3 years.

STEP BY STEP:
DOUBLE-EXTRACTION TINCTURE

1. Soak the dried fruiting bodies overnight in a bowl with 10 times the amount of hot water, weight to volume. (For example, soak 1 ounce of dried reishi in 10 ounces of water.)

2. The next day, cut the fruiting bodies into pieces.

3. Blend the mushroom pieces and soaking water on high speed until the result is a smooth liquid with few, if any, pieces left.

4. Pour the mixture into a pot and add enough water to make a thin slurry. Cook the mushroom mixture for 2 hours. Simmer with the lid off until the liquid is reduced to about a quarter its original volume, or even until it is just above the level of the mushroom solids.

5. After the mixture has cooled, strain the mushrooms in a jelly bag or a cheesecloth-lined sieve, then squeeze out the

dark, concentrated tea, wringing out as much liquid as possible. Pour the tea into a canning jar and refrigerate it.

6. Place the semidry marc in a blender, add enough high-proof alcohol to cover it, and blend well. Use 190 proof, or the highest proof alcohol you're able to buy.

7. Pour the marc-alcohol mixture into quart canning jars or other glass jars. After it settles, there should be ½ to 1

full inch of liquid above the marc; if not, add more alcohol. Let the marc macerate for 7 days at room temperature; shake the jar daily to speed extraction.

8. Pour the mixture through a fine-mesh sieve lined with cheesecloth, then squeeze out as much of the alcoholic tincture from the marc as you can. Measure the reserved tea concentrate and the tincture. In order for the finished

product to be shelf stable, the ratio of tea to tincture must be at least 75:25.*

*If you're using 100 proof vodka, however, the ratio of tea to tincture must be 50:50.

9. Combine the tea and tincture and mix well, then bottle. After the liquid sits overnight, a sediment will form. This sediment contains some beta-glucans and chitin, so shake the tincture before using.

CHOOSING MUSHROOM PRODUCTS OFF THE SHELF

The medicinal mushroom products you find in your local store may be made of mycelium or mushroom fruiting bodies, and there is a lot of debate among manufacturers which is the better product. Developing some understanding of how the

products are made and what the labels mean will help you select the highest-quality medicine.

ABOVE: Commercial products made from cultivated lion's mane may contain both the mycelium and the fruiting body.

Comparing Mycelium and Fruiting Bodies

Because of the greater efficiency of mycelium culture, companies in countries with the technology and know-how tend to grow and sell mycelium-based products. The main potential problem with mycelium products comes when the mycelium is harvested before it has a chance to consume all of the grain substrate. This means that there will be some starchy residue mixed in, essentially diluting the medicinal properties of the mycelium. In one study, researchers tested a number of store-bought products for beta-glucan content and found high levels of starch in some of them, along with low levels of beta-glucans. They found 24 to 87.7% alpha-glucans, nearly all in the form of starch or glycogen, in a range of commercial products.[3] These levels of starch in commercial products intended for immune-activating effects are not desirable and will result in products with lower activity. Another study on a variety of reishi products from around the United States, published in the prestigious journal Nature, showed that of the 19 products they tested, 14 of them had significant levels of starch and only 5 had significant levels of beta-glucans.[4]

HOW IT'S GROWN MATTERS. Excellent organic mycelium products can be produced when the mycelium is allowed to grow until it has consumed all the grain substrate. This requires the use of well-maintained cultures of vigorous strains and providing an extended growing period, to allow for the production of a high amount of mycelium. Medicinal products grown in that manner contain significant amounts of beta-glucans and other active compounds.

BOTH CONTAIN THE BENEFICIAL COMPOUNDS. In terms of its medicinal qualities, mycelium itself is not necessarily better or worse than the fruiting body. Many studies show that both the mycelium and fruiting bodies produce the key immunomodulating fungal beta-glucans in abundance — as well as terpenes, phenolics, and other bioactive compounds.[5] This is dependent upon the species and the substrate it was grown on, however. Wood-inhabiting species such as turkey tail, will typically have more beta-glucans in the fruiting body than the mycelium. Wild-collected turkey tail fruiting bodies, for example, contain up to 60% beta-glucans, while the mycelium contains just 15 to 30%. My lab research using the Megazyme beta-glucan assay kit has shown that turkey tail mycelium grown on rice can have higher levels of fungal beta--glucans than when grown on a liquid culture — about 30% versus about 17% grown on liquid media.

MYCELIUM IS EASIER TO BREAK DOWN. Another point to consider is that the active compounds in mycelium are more bioavailable than those in fruiting bodies. In one study, for example, pure turkey tail mycelium was boiled for 3 hours, and

researchers were able to extract 60% of the total available beta-glucans. When fruiting bodies were boiled for the same amount of time, only 14% of the available beta-glucans could be extracted. [6]

COMPLEMENTARY IMMUNE BENEFITS. In one study involving reishi, the researchers found that both the mycelium extract and the fruiting body extract had significant immune-activating activity, but each worked by activating different kinds of immune cells. So, one could argue that they were complementary in their action. [7]

THE BOTTOM LINE: COMPARE THE BETA-GLUCANS. I have seen mycelium-based products that guarantee up to 15% beta-glucans, similar to some fruiting body-based products. Unfortunately, there are mycelium-based products with low mycelium contents and higher starch contents (from undigested substrate), and this has led to a debate about whether fruiting body or mycelium is better. The truth is that both are good. The debate around fruiting body versus mycelium is misguided. The real debate is whether or not the product has a significant beta-glucan content and other active compounds.

The debate around fruiting body versus mycelium is misguided. The real debate is whether or not the product has a significant beta-glucan content and other active compounds.

Look for Fungal Beta-Glucan Levels

Consumers may have a difficult time determining the amount of starch and beta-glucans in the product they purchase. Some manufacturers label their products with a guaranteed percentage of polysaccharides. The problem is that the term *polysaccharides* can mean cellulose, starch, beta-glucans, chitin, or any other polymers that contain sugars or sugar derivatives that contain glucose. A product could comprise 60% starch, 10% chitin, and only 5% beta-glucans and still be labeled as containing 75% polysaccharides. This method of labeling could be confusing and misleading to some consumers. Starch or cellulose has little or no immune-stimulating activity, and it is not expected to have any antiviral or anticancer effects either. Better to look for a product with a guaranteed amount of fungal beta-glucan content, or other proven bioactive compounds.

In order to quantify their medicinal value, a few products on the market are beginning to show guaranteed levels of beta-glucans on the product label; it should say "standardized to beta-glucans." When you purchase a product that has 10 to 30% beta-glucans, you can be assured that you'll get a lot of immunological activity, as well as anticancer and antiviral activity.

Advocate for Standardization

If consumers want to be guaranteed that the medicinal mushroom products they're buying are effective, they should ask companies how their products are tested, and they should advocate for standardized testing of products across the board. At present, very few products have any guaranteed levels of beta-glucans or other active compounds like triterpenes. Unfortunately, those manufacturers that do list beta-glucans levels may not use a testing method that's accurate.

Fortunately, one authenticated method is available and is widely used in research labs around the world for accurately determining the alpha-glucan or starch content of a product, as well as the beta-glucan content: the Megazyme method. Megazyme is a company in Ireland that produces kits for measuring food components like starch, glucans, glucose, and other sugars and polymers. In a peer-reviewed article, the authors validated the method used to measure immunologically active fungal beta-glucans, and the starch content (alpha-glucans), in a number of dried mushroom fruiting bodies as well as commercial products taken from the shelves of natural foods stores. [8]

If the current situation of lack of standardization is to change, more independent lab testing and more oversight will be needed to ensure the methods being used to determine the beta-glucan content of products are accurate. In the meantime, I encourage consumers to contact mushroom product manufacturers and ask them how their products are tested. You can also test products for yourself; see DIY Beta-Glucan Testing.

MYCELIUM IN CLINICAL TRIALS

Here's one key point to remember in the debate over whether mycelium or fruiting bodies make a better product: Of the more than 37 controlled human clinical trials showing the positive effects of turkey tails as an effective supplement for supporting patients with cancer who are undergoing chemotherapy and radiation therapy (see Cancer Support), virtually all have been performed with products (such as PSK and PSP) that were made from 100 percent mycelium. For the purposes of the clinical trials, the mycelium is cultured in a nutrient broth rather than on rice or other grain substrate, so when the mycelium is harvested and the nutrient solution drained off, the result is pure mycelium. This simply emphasizes the point that neither the mycelium nor the fruiting body is

inherently superior. The *amount* of fungal biomass and beta-glucans as well as the total diterpenes, triterpenes, phenolic, and other bioactive compounds in the product make a difference.

STEP BY STEP:
DIY BETA-GLUCAN TESTING

You can test any commercial mushroom product for starch content simply by using iodine solution (potassium iodide). A number of brands are available online in 1- or 2-ounce bottles.

odine

1. Empty a few capsules of powdered mushroom product, or a dropperful of a liquid product, into ¼ cup water. Mix well. The color should be amber to light brown.

2. Add a dropperful of the iodine solution and stir. Evaluate the color.

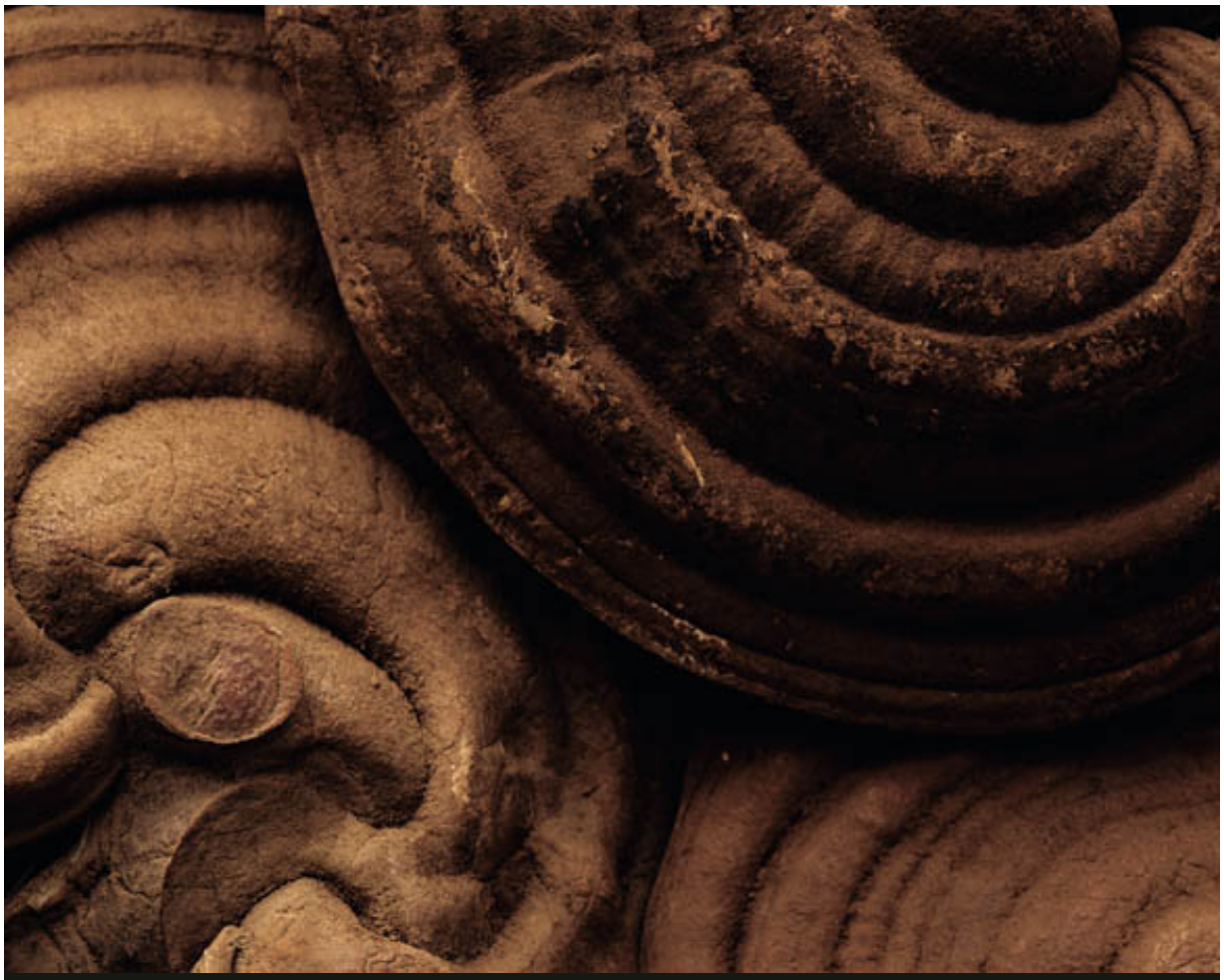
3A. The tested liquid of a high-quality product will stay brown, perhaps with only a slight blue tint to it. This means that very little, if any, starch is present. If the liquid turns blue but quickly fades to brown, a little starch is present.

3B. If the liquid turns blue, especially if it is bright blue or dark blue, and it stays blue, then a lot of starch is present (likely from an undigested substrate, like rice, since mushrooms produce very little starch). A decided purple color can indicate that a significant amount of glycogen is present.* If the liquid turns purple or blue-purple, that is a little better than just blue.

*Glycogen is a glucose storage molecule fungi produce from an abundant food source like starch for fast release of energy. Fungi store up glycogen for use when they make fruiting bodies, which requires a lot of energy. One small study found that the fungal glycogen itself actually has some immunological activity, but it is still much preferable to have a high beta-glucan content and very little starch or glycogen. [1]

3

TOP MEDICINAL FUNGI



In the pages that follow, I have collected and summarized the available evidence so that you have a sense of the likelihood that a given species will provide the benefits you are looking for. In many cases, the scientific evidence supports popular traditional and historic uses.

A REVIEW OF THE BENEFITS

As an herbalist with extensive clinical and field experience, I promote the idea of mushrooms as food and medicine being a very healthy addition to our lives. As a scientist, my passion is to critically review and summarize the most relevant science that could help uncover hidden benefits of mushroom medicine, as well as support or dispel ideas about how to best benefit from it.

When I evaluate the potential benefits of a mushroom species and make recommendations for my patients, friends, and family, I consider both the long history of traditional use, along with any scientific evidence of a mushroom's effectiveness for treating symptoms and disease, for preventing disease, and for general health benefits. The traditional use says a lot about the safety of a particular species. For instance, reishi has been known and revered as a medicine for more than two thousand years. That's a long track record.

However, many questions about the benefits of medicinal mushrooms are not centered on their safety (because they are so safe under most conditions), but on their efficacy for specific uses. Again, the long history of use of reishi, for example, for addresssing respiratory tract problems and cardiovascular problems and for activating the immune response against cancer and infections is strong evidence in support of commiting research dollars to further and more definitive studies. In fact, there are thousands of published studies on the health benefits of reishi and in some cases, results from human clinical trials support reishi's use for specific conditions and symptoms.

CHOOSING SPECIES TO INCLUDE

The species of mushrooms included in this chapter are the most studied and widely used in traditional medicine, in natural care clinics, and among practitioners who embrance

integrated medicine. In this chapter, you will find historical and background summaries on the species and brief details of human clinical trials performed on extracts of the species. All of these mushrooms have animal studies (in vivo) or laboratory studies using human or animal cell cultures (in vitro) to support their biological activity, clinical benefits, and health benefits. These studies have to be considered preliminary because cell cultures and even live animal studies do not necessarily equate to their actual benefits in humans for relieving symptoms or supporting your immune system to fight off infections or even cancers.

THE VALUE OF CLINICAL TRIALS

Compared to assays performed in vitro (literally “in glass”) and studies involving animals, human clinical trials say a lot more about the benefits of a mushroom species. Unfortunately, only a few traditionally used species have solid clinical trials that are up to today’s high standards needed to call the benefits “evidence-based.” However, they are suggestive, and when patient volunteers in the studies do appear to receive benefits that are statistically significant, it can bolster the argument for using a particular mushroom for specific symptoms and long-term benefits.

Clincial trials are also valuable in that they often report side effects that may occur in some of the participants, compared with those in the placebo group. The good news is that most, if not all, clinical trials with mushroom extracts have reported very few unpleasant symptoms, and if there are mild

symptoms such as digestive upset, they are comparable in number to those taking a placebo.

Clinical trials also give us valuable information about the dose (actual amount administered, usually in milligrams or grams), and dosages (how many times a day it is taken) that have the best outcomes and provide the largest benefits when taking mushroom medicines. The duration of treatment is also addressed, as trials usually last for four to six weeks up to months. This can be of value for understanding how the extract works over time. Does the beneficial effect being measured (such as an immune response) weaken or strengthen over weeks, or do any side effects develop with continued use?

A Word about Study Size

In the world of medical research, studies with fewer than 50 volunteers are usually considered small; more attention is paid to studies with more than 100 volunteers. However, even small studies are useful for pointing out how safe a treatment is. If as many people taking the mushroom extract had minor side effects as those on placebo, then this is a very safe remedy. These small studies also give us some encouragement that the treatment is likely to be effective.

ABOVE: *Agaricus subrufescens*

AGARICUS

Agaricus subrufescens and other species

First described by Charles Horton Peck in 1893

OTHER NAMES: Almond-scented agaricus, sun agaric, *himematsutake* (Japanese), *ji song rong* (Chinese), *cogumela del sol* (Portuguese)

The genus *Agaricus* includes the familiar button, crimini, and portobello mushrooms (all are *A. bisporus*, marketed at different stages of growth). This is the most commonly cultivated mushroom in the world, and although it's a healthful and delicious food, other species in the genus have much more medicinal value. *A. subrufescens* is the species most often found in commercial medicinal products, valued for its potential in treating a variety of ailments.

OVERVIEW OF POTENTIAL BENEFITS

Decrease in insulin resistance for people with type 2 diabetes (when accompanying healthy lifestyle changes)
Cancer support
General immune support
Liver support to reduce inflammation; hepatitis support

Summary of Research Findings

Agaricus subrufescens (previously called *A. blazei* or *A. brasiliensis*) has been used in traditional medicine and is widely available as a dietary supplement under various brand names. So far, 10 small, mostly preliminary published clinical studies are reported in PubMed, the world's largest online

medical database. The products used in these studies are nearly all capsules containing hot-water extracts of *A. subrufescens* fruiting body or mycelium. The fruiting body and mycelium of this species are both found in commercial products; mycelium product quality may be more variable, and either is included in mushroom combination products. The active compounds most researched from the agaricus mushroom are various beta-glucans and other cell wall materials.

Promising results included:

- Some benefits for reducing side effects of chemotherapy for 39 patient volunteers with various cancers (ovarian, cervical, and endometrial), such as nausea, hair loss, and general weakness, as well as increasing natural killer cell activity, which can be depressed during standard treatment. This was compared with 61 patients who took chemotherapy alone (three rounds of three weeks each). [1]
- Significantly improved insulin resistance in patients with type 2 diabetes compared with a placebo (among 72 patients, 29 patients took 1,500 mg of *A. subrufescens* for 12 weeks). [2]
- Improved immune response, lower blood sugar values, lower total cholesterol, and improved kidney function in 28 patients with colorectal cancers (stage I, II, and III). [3]

In addition to the findings above, a few small preliminary studies have shown promise for potential benefits for patients with hepatitis C and B; in particular, supplementation with *A.*

subrufescens for 12 months was associated with a reduction in liver enzymes. [4]

Traditional Uses

Various species of *Agaricus* are used in Brazil and Japan as health supplements, as well as gathered from the wild and eaten to help prevent and ease symptoms of diabetes and cancer and as a general health tonic.

Dosage

Studies show that an effective dose is 1,500 mg (1.5 grams), which is about ½ teaspoon, or three or four "00" capsules.

What to Look for in Commercial Products

Products should have as little starch as possible. Use the iodine test (see the step by step) to check the product yourself unless the product is made only from fruiting bodies, which don't produce starch.

Identification in the Wild

Keep in mind that although some *Agaricus* species are edible and delicious, not all are; some found in the wild are quite nauseating. So be sure to clearly identify wild-harvested mushrooms before consuming them.

ABOVE: An agaricus with a chemical smell and a stalk that quickly stains yellow will not be edible.

HABITAT. Agaricus mushrooms are found in leaf litter in cultivated gardens. *Agaricus augustus*, commonly known as the prince mushroom, is also found by roadsides and near deciduous and coniferous forests. It is one of the best edibles in the genus *Agaricus*.

SPECIES. *Agaricus subrufescens*, the main cultivated species for making medicinal mushroom products, has also been found in the wild in the southeastern United States. Another common wild and indigenous US mushroom is the well-known choice edible species, *A. augustus* (the prince mushroom); both smell of almonds and *slowly* stain yellow when bruised. I wouldn't hesitate to use the prince for the same indications as the closely related medicinal *A. subrufescens*.

ID TRAITS. *Agaricus campestris* and other edible agaricus are nearly identical to the button mushrooms at the grocery store. All members of the genus have chocolate brown or blackish brown spores. They also have a ring of felty tissue on the upper stem, and no vulva (the cup of tissue on the base of the stem). When you pull an agaricus out of the ground, pinch off the base of the stem and see if it *quickly* stains yellow; this is a sign that you should not eat it. Smell the base; an odor like chemicals or glue also means that it should be rejected. If the staining reaction doesn't happen and there is no smell or a pleasant smell, then regard it further. If handling or rubbing the cap or stem results in a red stain, a slowly developing yellow stain, and/or a pleasant smell — an odor of sweet almond extract or marzipan — then the mushroom is typically edible.

LOOK-ALIKES. Members of the genus *Amanita* look very similar to *Agaricus* species and can be quite toxic, even lethal. However agaricus don't have a cup at the base of the stem, as amanitas do, and they don't have white or yellow spots or patches on the top of the cap. As a final test, take a spore print (see Taking a Spore Print). The spores of all *Agaricus* species will be chocolate to black-brown. Look-alike mushrooms from the genus *Amanita* will always have a white spore print. In this case, identifying a mushroom by its spore print really is black or white!

ABOVE: *Agaricus campestris*

ABOVE: *Agaricus augustus*

Harvesting, Processing, and Using

Harvest edible or medicinal *Agaricus* species in late summer, in fall, or in winter (before freezing temperatures arrive) in pastures or in the forest litter. They like decaying leaves and other rich organic matter. Cut off the bottom of the stem that was in the soil, as the earthy taste may linger. Brush off soil and litter from the cap and stem. Rinse them when you get

home and check them for worms if they are soft; trim off any bad spots. Store in the refrigerator for up to five days in a wax paper sandwich bag or small paper bag. They tend to degrade and rot sooner if stored in plastic bags.

CHAGA

Inonotus obliquus

First given its present name by Albert Pilát in 1936

OTHER NAMES: clinker polypore, *kabanoanatake* (Japanese)

Chaga is a fascinating fungus — technically, it's a "fungal sclerotium," a sterile mass of highly condensed mycelium. It has been used for centuries in traditional and folk medicine, especially by the Khanty people of Siberia to prevent tuberculosis and protect the heart, and as an anticancer remedy in Russia, Siberia, and other parts of eastern Europe. The name *chaga* is derived from the word for "mushroom" in the Komi-Permyak language of the Uralians in the Kama River basin. Recently, the popularity of this interesting fungal creation has spread to other areas of the world.

OVERVIEW OF POTENTIAL BENEFITS

Antitumor activity
Antioxidant
Immunomodulating
Blood sugar balancing
Cardiac support
Antiviral, antibacterial

ABOVE: *Inonotus obliquus*

Summary of Research Findings

Chaga is known to contain over 200 different bioactive molecules. Betulinic acid, which gives the inside of the sclerotia a yellow-orange color, is known to have anticancer, antiviral, antibacterial, anthelmintic (antiworm), and antiparasitic effects. Birch bark, the main host for chaga, contains up to 25 percent betulinic acid. The anticancer property is consistent with its ability to induce apoptotic cell death in cancer cells through the mitochondrial pathways in cancer cells. Although betulinic acid has a potent cytotoxicity (cell toxicity) against a variety of cancer types, many normal cells and tissues have resistance to betulinic acid, increasing its benefit as an anticancer remedy. [5]

Research findings show that the sclerotium extract can directly inhibit cancer cell growth, while the cultivated mycelium extract has more potent effects to increase your immune system's ability to destroy cancer cells. This research suggests that an extract of both the mycelium and wild--harvested sclerotium together could be more powerful for fighting cancer cells, and for prevention. [6] The low immunomodulating effects of the sclerotium is not surprising, since the decoction from crushed sclerotia has only about 1.2 percent beta-glucans in it. [7]

The dark black exterior color of the sclerotium comes from melanin, which has immunomodulating effects. Potent anti-oxidant phenolic compounds such as caffeic acid derivatives, as well as many triterpenes and diterpenes, are also found in significant amounts, along with mycelium cell wall polymers such as beta-glucans and chitin. The terpenes, chitin, and beta-

glucans all have immune-stimulating and immunomodulating effects.

Quite a few laboratory studies in cell cultures and animals have been conducted with chaga extracts, showing that it has antioxidant, blood-sugar- and insulin-regulating, antitumor, antimutagenic, and immune-stimulting activity, as well as direct antiviral and antibacterial effects. [8]

Few human clinical trials can be found on PubMed. Some are available in Russian: two from 1973 and 1981 with volunteers with psoriasis and pain from stomach ulcers, both of which showed some benefits. The tincture was taken 1 teaspoon to 1 tablespoon three times daily.

A WORD ABOUT OXALATES

Wild chaga has an intermediate amount of soluble oxalates — a natural substance found in plants that, when consumed in very large quantities, can cause kidney stones. Levels in wild-harvested chaga range between those found in foods like almonds, cereal grains, and peanuts, and vegetables known to be high in oxalates, such as spinach, rhubarb, and beet greens. Other common mushrooms have much lower levels of soluble oxalates. [18] No analyses of total soluble oxalate content seem to be available for cultivated chaga mycelium, but because fungi produce a considerable amount of soluble and insoluble oxalates as they metabolize wood, it makes sense that

wild-harvested chaga would produce more than chaga cultivated on grain. [19]

There is just one study that associated prolonged consumption of chaga with a case of kidney stress and damage, in a 72-year-old Japanese woman with a history of liver cancer. [20] She consumed 4 to 5 teaspoons of chaga powder in hot water daily for six months after being diagnosed with liver cancer. At the end of six months, she presented with kidney damage due to oxalate crystals. It's not clear, however, whether her kidney failure could have been a result of ingesting chaga in conjunction with nephrotoxic medications, including chemotherapy. [21]

The oxalate problem is easily avoided by consuming a highly soluble form of calcium, such as any milk product, with your chaga. When consumed with calcium, oxalates are precipited as calcium oxalate in the digestive system and harmlessly passed in the feces. It's still a good idea to discuss chaga consumption with your health-care practitioner if you are on a low-oxalate diet or have had problems with kidney stones in the past, if you are pregnant or nursing, or if you are immunocompromised.

Traditional Uses

In Russia, Ukraine, and other eastern European countries, chaga is widely used as a folk remedy for cancer prevention and treatment; for its free-radical-scavenging antioxidant

effects; to treat blood sugar and insulin imbalances; to treat heart disease; and for its direct antiviral and antibacterial effects, as well as for anti-inflammatory and immunomodulating effects. [9]

The fungus is also recommended in traditional use for tuberculosis, gastric complaints, liver diseases, heart disease, and gastrointestinal cancer. [10]

It's often used in Siberia for preventing and treating infections, to prevent and treat tuberculosis, and as a remedy for heart, liver, and stomach problems. The sclerotia are still crushed by people and decocted for tea in Siberia in villages that follow some traditional ways. [11]

The best story I've heard about chaga is from a Ukrainian patient I consulted with. She told me that she had two brothers who both were diagnosed with kidney cancer within a short time of one another. One brother took the natural route and changed his diet and used chaga tea and tincture every day. The other brother decided to use conventional medicine, including chemotherapy. He did not take any chaga. It turns out the brother who used daily chaga lived for another six years, while the other brother lived for only two years more. Both of them died from causes related to the cancer. She also said the health and quality of life was much greater for the brother using a more natural approach. She made it clear that chaga is famous in Ukraine and Russia, well known by most people for treating cancer as well as for maintaining general health. Many prepare a tincture of the crushed sclerotium in vodka, she said, but they also boil it, making a strong decoction.

Dosage

My recommendation is to make a decoction by simmering 3 to 15 grams (or up to 25 grams for more serious ailments like active cancers) of the crushed or powdered sclerotium in 10 times the amount of water for 30 to 60 minutes. The strength of the decoction should be adjusted according to the size, weight, and current health status of the person who will consume it, as well as according to the person's ability to tolerate digestive upset or other side effects of the decoction.

After simmering, a double-extraction tincture can be made (see the step by step). The tincture dosage is 1 teaspoon two to three times daily for maintenance and prevention, up to five times daily for serious diseases.

The traditional way to prepare chaga is to pour 500 mL of boiled water over 10 grams of chaga and infuse for one hour. Strain and bring the volume of the water back up to 500 mL. Take 200 mL three times daily.

What to Look for in Commercial Products

Make sure to check the label to determine whether the product is made from the wild-growing sclerotium or the cultivated mycelium. Wild-harvested chaga is the traditionally used form, and more potent in some ways, but cultivated mycelium products are a more sustainable option. These can also be good if they have been tested for beta-glucans or triterpenes and guarantee a specified amount. You can test any product you buy with the iodine test to make sure it is not full of starch (see

the step by step). Wild-harvested chaga will contain no starch at all.

Because chaga is so much a part of Russian culture, many different Russian wild-harvested chaga powders are available online. They are especially promoted for aiding people with "chronic gastritis," or stomach inflammation. Contraindications on these products include cautions to not drink chaga tea while breastfeeding, during pregnancy, or with dysentery or colitis.

Identification in the Wild

HABITAT. Chaga is found in forests of northern latitudes like Siberia, eastern Canada, and the northeastern United States. Little is known about the ecology and biological interactions of the chaga and the tree. The black, irregular sclerotia grow out of birch trees — and sometimes other species of hardwoods, such as beech and oak — after infection by the fungus.

Although a sclerotium is defined as a sterile production of the fungus densely packed with mycelium, one research team estimated that only about 10 percent of the mass is actual fungal tissue, and the rest is degraded wood from the tree.[12] Some of the fungal active constituents could migrate into this tissue as well, but little research is available on this point. The spore-producing fruiting body is small and mostly grows under the bark of the tree when parts of it have died.

Chaga can grow on living trees, and its sclerotium often can be observed growing out of tree wounds. Over years of observing it, I have held the theory that the sclerotium might

act as a kind of scab to protect the tree where the mycelium is coexisting with the living host tree.[13] Some researchers consider chaga a parasitic species or true pathogen for the tree, usually killing the host within 20 years. However, infected trees have been observed to last as long as 80 years.[14]

ABOVE: Chaga on birch

ABOVE: *Apiosporina morbosa*, a chaga look-alike, growing on a cherry tree

ID TRAITS. Chaga looks like a big, cracked lump of charcoal. When crushed, knocked, or pried from the tree, the yellow-orange to gold interior is revealed. The black sclerotia can be small and not extending much away from the trunk, or they can be very large, up to a foot across. The actual fruiting body is small and rarely seen; it emerges for only brief periods and sometimes under the bark. The dark, charcoal-looking growth is easily recognizable, however.

LOOK-ALIKES. Chaga has only one true look-alike: *Apiosporina morbosa,* which typically grows on cherry or other *Prunus* species. Other conks (hard fungal fruiting bodies) do grow on a variety of trees, but they do not have the cracked, irregular, black exterior with a yellow-gold to orange interior. You might see other conks growing on conifers, but you can eliminate these. I have been fooled a few times by dark, abnormal tree growths, perhaps caused by a viral infection, but these are not fissured and irregular like chaga. The best advice for avoiding look-alikes is to only harvest from birch trees.

Harvesting, Processing, and Using

The growth is typically harvested with a hammer and chisel and ground up for teas, tinctures, and other products. The crushed or ground-up chaga tastes rather like vanilla; many people add spices like ginger, cloves, pepper, or cardamom to make a "chaga chai."

There has been some discussion recently about the sustainability of harvesting chaga from the wild. Some collectors have told me that thousands of miles of birch trees with chaga growing on them occur in the far north of eastern Canada. Others have told me they are slow growing and commercial harvest will eventually be unsustainable, particularly if demand keeps increasing. However, published research has shown that a chaga sclerotium can grow back within four to seven years of harvest (depending on the size). One published informal assessment of sustainable commercial harvesting using count estimations in the far southeast of

Russia concluded that since the resources were vast, with current trends in mind, harvesting is sustainable. [15]

Fortunately, many mushroom growers are cultivating the mycelium on cooked rice or other substrates. The mycelium is what is in the natural black sclerotium on the tree, and the fruiting body or sporocarp is not ever used, so this seems appropriate. The only caveat is the product should contain low starch and ideally be tested for beta-glucans, triterpenes, or total phenolic compounds. One possible issue is that neither the immunomodulating black melanin nor the antitumor betulinic acid is likely to be found in the cultivated mycelium or, at best, it would be in much lower amounts than the sclerotium. Still, this is not a deal breaker because the immunomodulating and anticancer effects from the high triterpene and modest beta-glucan content, as well as the significant amount of antioxidant phenolics (such as benzoic acid derivatives like caffeic acid) will still occur in cultivated products.

In one study, chaga sclerotium hot-water extracts had the highest antioxidant effects by far of any mushroom extract studied, including reishi, phellinus, and agaricus. [16] The antioxidant action is mainly due to polyphenolic compounds that are mostly water soluble, whereas the triterpenes in chaga are more alcohol soluble. [17] (And the polyphenolic compounds become even more available when the chaga is cooked under pressure, either in a pressure cooker or a multicooker.) The triterpenes have liver-protective and anticancer effects. Besides decoctions, for these effects it appears that a double extraction will also be effective.

CORDYCEPS

Ophiocordyceps sinensis, *Cordyceps militaris*

O. sinensis, the currently accepted Latin name, was first published in 2007 by Gi-Ho Sung and others.

C. militaris was first published by Elias Magnus Fries in 1818.

OTHER NAMES: Caterpillar fungus, *yartsa gunbu* (Tibetan), *dong chong xia cao* (Chinese, meaning "winter worm, summer grass")

Wild cordyceps is, essentially, a ghost moth caterpillar that has been completely digested by the fungal mycelium of *Ophiocordyceps sinensis* (previously categorized as *Cordyceps sinensis*), which produces a club-shaped fruiting body that emerges from the head of the caterpillar. It has been revered in traditional medicine for over a thousand years. However, because wild cordyceps is in limited supply and is more expensive than gold, *Cordyceps militaris* is used as a sustainable and effective alternate.

OVERVIEW OF POTENTIAL BENEFITS

Protects the kidneys, especially for patients with chronic kidney disease

Boosts energy levels and endurance during sports

Increases sexual vigor

Alleviates chronic lung complaints, such as wheezing and chronic coughs

Used as a regular tonic for the elderly, to stimulate active energy and warmth.

Cordyceps militaris

Summary of Research Findings

Cordyceps is one of the most popular medicinal mushrooms in the United States and many other countries because of claims that it increases energy and sexual performance, improves endurance, slows the aging process, and counteracts stress. Neither *Cordyceps militaris* nor *Ophiocordyceps sinensis* have many clinical trials to support these claims, however. Many of the perceived benefits of *yartsu gunbu,* the Chinese caterpillar fungus, come from over a thousand years of traditional use and cultural reverence. However, *yartsu gunbu* itself has been associated with several different fungi; how much of its revered medicinal properties come from species other than *O. sinensis* is a subject for debate. [22] Further research is needed.

Some research has been carried out with *Paecilomyces hepiali*, a related species known as Cs-4. Two small clinical trials conflicted on whether *P. hepiali* can increase energy and counteract fatigue. One trial studied exercise performance among elderly participants who received 333 mg of three times a day for 12 weeks and then a placebo for 12 weeks. [23] Seven volunteers received the placebo and eight received the Cs-4 preparation for 12 weeks. Those receiving the Cs-4 had a 10.5% increase in the metabolic threshold and an 8.5% incease in the ventilatory threshold, compared with those taking a placebo. Both of these thresholds are markers of improved aerobic function. Higher values indicate the increased accumulation of lactate, leading to sore muscles and reduced performance. Considering the small number of subjects and the modest improvements of 10% and 8.5%, this is not a robust finding and

should be considered preliminary. A similar study with 22 male cyclists taking 3 grams/day of the same product concluded that no benefits in endurance could be seen in those receiving the Cs-4. [24]

Ophiocordyceps sinensis

A recent controlled human study involving 98 patient volunteers with chronic kidney disease found that a *C. militaris*

preparation (100 mg/day for 3 months) had significant kidney protective effects, improving kidney functions and slowing the progression of the disease. [25]

Clinical studies also show cordyceps's efficacy for supporting and protecting the kindey against the toxic pharmaceutical drug cyclosporin. The most recent review and meta-analysis (pooling of statistical data) of nine clinical trials with organ transplant patients showed that those who took a popular Chinese Cs-4 extract while receiving graft rejection drugs like cyclosporin experienced improved kidney function and reduced complications. Their conclusion was that Cs-4 used along with the kidney-toxic antirejection drug "may benefit kidney transplant patients." They also added that better quality studies are needed to define the size of the benefit. [26]

Can we extend these findings to recommend the use of Cs-4 for protecting the kidneys against all pharmaceuticals? Many are stressful to the kidneys, the organ that has to excrete the toxic by-products. My view is that no other herbal remedy has the same level of evidence for protecting the kidneys, and since Cs-4 is nontoxic, it is certainly worth a try for six to eight weeks to evaluate the benefits.

Cordyceps contains bioactive compounds like beta-glucans, which all fungi produce, as well as some bioactive nucleosides like cordycepin and adenosine. Small amounts of sterols, amino acids, and polypeptides are also known. However, a lot of these are common in other mushrooms.

Traditional Uses

Cordyceps has been known and used for many centuries, especially in parts of Asia. At one time, it could be obtained only by royalty because it was so scarce. According to a centuries-old tradition, cordyceps is a functional food, which purportedly gives you sexual potency, along with energy, vitality, and endurance. It is most widely known as a supplement athletes use to boost their energy and endurance during sporting events.

Perhaps one of the reasons cordyceps is perceived to boost sexual potency is because of how it looks. The doctrine of signatures indicates that an herb or fungus has a benefit and action on the body that is represented in the appearance of the herb or fungus. In this case, the caterpillar has a phallic fruiting body projecting straight up out of its head. I will leave the rest to your imagination.

Wild cordyceps is a cultural treasure in China. Traditionally, it is eaten only on special occasions because it's so expensive. These days, it's literally as valuable as gold, costing thousands of dollars an ounce. Cordyceps is sometimes given as a gift to business associates and to friends or relatives. The package containing wild cordyceps bundles often has a beautiful wrapper with a ribbon on it. When it is opened, you can see the caterpillars with fruiting bodies coming out of their heads — a big joy to the person receiving it.

In traditional Chinese medicine, cordyceps is often recommended by herbalists in the clinic for gastric, cervical, and oral cancers, hepatitis B or C and other infectious diseases, asthma and other forms of bronchial and lung inflammation, as well as to protect the kidneys when one is using drugs that can stress or harm them. Traditionally used as a lung tonic for

asthma, for people with weak lung function in general, and to stop wheezing and coughs, cordyceps is often recommended as a general tonic for the elderly to strengthen "yang," or the warmth and "active energy" of the body." Cordyceps is shown to have anti-inflammatory, antioxidant, blood-sugar--regulating, kidney-protective, antitumor, and immunomodulating effects. Many of the biological effects related to traditional uses of both *O. sinensis* and *C. militaris* have been demonstrated in animal studies as well, including a testosterone-stimulating effect. [27]

ABOVE: Finding and collecting wild cordyceps is a painstaking process for these harvesters on the Tibetan Plateau.

Dosage

For the mycelium grown on grains, or the orange fruiting bodies of *C. militaris*, the dose is 2 to 5 grams twice daily. For an extract, it's 1 to 2 grams twice daily. A "00" cap can hold 300 to 400 mg of powder but more of the extract because it is more dense.

ABOVE: *Cordyceps militaris* growing on rice

What to Look for in Commercial Products

Because wild cordyceps is so expensive, cordyceps products sold in the United States are typically made from the cultivated mycelium of *Cordyceps militaris* — a species that has activity and benefits similar to those of wild cordyceps, according to

chemical and pharmacological analyses. After extensive review of the literature, I have concluded that *C. militaris* is a good substitute for *O. sinensis* because it has many of the same active compounds and supports similar biological activity. Look for products that are a combination of mycelium and fruiting body. Be sure to test a product before using it, to determine the starch content (see DIY Beta-Glucan Testing).

CORDYCEPS USE IN SPORTS

In 1993, cordyceps was in the news because during the National Games of China, in Beijing, Chinese women runners broke a number of world records. The coach was questioned about performance-enhancing drugs, but he claimed it was the use of cordyceps that made the difference. Later it was found a few of the runners did use banned performance-enhancing substances as well as the cordyceps. However, some of the athletes only used cordyceps and still did well.

Analyzing the Species on the Label

The Chinese cultivate and sell a number of fungal species that are found either in the soil adhering to the caterpillar or on the sporocarp of *O. sinensis,* and many other local species that look like wild cordyceps are also sold in Chinese markets, including

C. gunnii and *C. cicadae.*[28] I am familiar with six such species that are sold on the US market. Some of these species have very little in the way of supporting in vitro and in vivo studies, but a few, like Cs-4, have more.

Unfortunately, they are often improperly labeled as cordyceps, even when they're not closely related. Regulations have not been in place to alter this; one solution would be for companies to always label the front of the package and the ingredients panel with the species or isolate included. Until this is regulated, consumers should understand what the various species are.

"CORDYCEPS" CS-4. Properly named *Paecilomyces hepiali,* this is a widely marketed species in the United States and many other countries and appears in the two or three most popular products labeled cordyceps in China. The latest DNA research shows that *P. hepiali* is likely only a minor part of wild cordyceps, among many other species of fungi from the soil around the caterpillar and on the outer skin of the caterpillar, as well as inside the sclerotium and sporocarp.[29] Ironically, though, Cs-4 is the material used in most of the published clinical trials for kidney benefits and immune stimulation in humans. Many laboratory studies are also published in the scientific literature showing the biological effects noted previously.

Cs-4 is popular in China because of its lower cost. Sales of several million dollars per year are reported. My only caution with this product is that it is often labeled as "cordyceps," which it is not, which means in a way the product is trying to

get in on the fame and long cultural acceptance and history accorded wild cordyceps. Cs-4 is the most popular and widely sold nonwild cordyceps product and has been around since at least the mid-1980s, when clinical reports on its benefits were published in China, helping to popularize cordyceps in the West.[30] Cs-4 is also listed in the Chinese Pharmacopoeia, a testament to its huge popularity in China.

BIONECTRIA OCHROLEUCA. This is another species cultivated and widely sold in the United States. It is not genetically related to cordyceps, and yet I have seen supplements labeled as "*Bionectria ochroleuca* (*Cordyceps sinensis* mushroom)," which is misleading. *B. ochroleuca* may have health benefits (according to its manufacturer), but very little research has been published about it in peer-reviewed journals.

TOLYPOCLADIUM INFLATUM. In my DNA research on cordyceps, I found that a few of the products I tested that were labeled as cordyceps or *C. sinensis* really contained the cultivated mycelium of a fungus called *Tolypocladium inflatum* (also known as *Cordyceps subsessilis*). This fungus may have some interesting benefits as an immune modulator because it has both immune-activating and immune-suppressing effects. The species contains small amounts of the well-known immune-suppressing compound cyclosporin, which is used for preventing organ rejection and for easing symptoms related to autoimmune diseases such as hepatitis.[31]

Using a "cordyceps" product that actually contains *T. inflatum* for the immune-calming effects of cyclosporins is

basically “microdosing” the drug. The side effects will no doubt be low, but clinical efficacy for things like Crohn’s disease, arthritis, autoimmune hepatitis, or others is unknown at present. Still, a regular course for six weeks is worth experimenting with, in my experience.

Identification in the Wild

Cordyceps is a wild fungus that infects and consumes several different insect species. It causes caterpillars to move up just beneath the surface of the ground and orient themselves vertically, so the eventual spore-producing fruiting body can project up into the air to disseminate the spores. (For a real treat, I recommend streaming the short film *Cordyceps: Attack of the Killer Fungus*, narrated by David Attenborough. It’s spooky, but fascinating!)

ABOVE: In China, cordyceps is a revered and very expensive medicinal fungus.

HABITAT. *Ophiocordyceps sinensis* (formerly *Cordyceps sinensis*) is not found in the United States, but *C. militaris* grows wild in the eastern states and other regions (though it's not commonly found west of the Rocky Mountains). *C. militaris* typically grows on submerged moth or butterfly larvae in rich, loose soil, well-decayed wood, or moss. Make sure to dig down into the duff to recover the buried insect as well as the orange, spindle-shaped fruiting body.

IDENTIFICATION. *C. militaris* infects caterpillars and pupae of several moth and butterfly species producing orange, club-

shaped fruiting bodies 2 to 8 cm tall, often with a longitudinal groove.

LOOK-ALIKES. A number of members of the *Cordyceps* genus occur around the world and fruit on a variety of insects, including ants, cicadas, and moth and butterfly caterpillars. Although it is possible to find cordyceps fruiting on cicadas, grasshoppers, spiders, or even ants, you likely won't find enough of them to make harvesting worthwhile.

Harvesting, Processing, and Using

If you are lucky enough to find enough of the bright orange fruiting bodies in the wild, wash the dirt off of the larvae, dry them carefully, out of direct sunlight, and store them in air-tight glass jars. You can tincture these in 70% ethanol (strong vodka), make a double extraction, or brew them as a tea by simmering for 30 minutes, then straining and drinking one cup of tea daily. The remaining tea can be stored in the refrigerator for up to a week.

Approximately 95% of *Cordyceps sinensis* is found in Tibet. Because of the high price of cordyceps, Tibetan families have been combing the high plateau in search of *O. sinensis*, searching inch by inch, looking for fruiting bodies. The sale of a few could feed their family for a significant time, as well as allow them to buy needed tools, clothing, and other goods. This kind of intensive harvest definitely isn't sustainable in the long run.[32] The cordyceps harvest has revolutionized the economy in places where it can be foraged, but it has had a

strong impact on the whole ecosystem — the biological system of the moths and the shrubs that serve as their food, as well as the animals that feed on the moths.

Because this harvest is not ecologically sustainable, people have been trying to figure out how to grow fruiting bodies and grow wild cordyceps for a long time, but it has been difficult to simulate the natural conditions where it grows. Recently, there was a breakthrough in China, and a few companies have been able to produce cultivated fruiting bodies of *O. sinensis* on farmed caterpillars. However, it's slow and not cost effective at this point. Eventually they may be able to produce enough to meet the demand, but it is just beginning to be economically viable at present. [33]

ABOVE: *Ophiocordyceps sinensis* on sale in Tibet

IF IT'S LABELED "*O. SINENSIS*," IT PROBABLY ISN'T

Whichever product you buy, be wary of anything claiming to contain the true wild *Ophiocordyceps sinensis* (or the out-of-date name *Cordyceps sinensis*). I have extensively studied labeling issues with cordyceps, and have tested the DNA of products labeled as cordyceps, and have not been able to identify a single product that contains true *O. sinensis* on the US market. However, the products labeled

as *Cordyceps militaris* do contain *C. militaris* — another reason they are the best choice on the market today.

LION'S MANE

Hericium erinaceus

First described by Christiaan Hendrik Persoon in 1797

OTHER NAMES: Bearded tooth, monkey's head, bear's head, *yamabushiitake* (Japanese), *hou tou gu* (Chinese)

Lion's mane is a beautiful, coral-like or shaggy mushroom that is not only an exciting medicinal species but also a delicious edible. It's always a pleasure to find in the wild, and it can be purchased online, in specialty grocery stores, or even from local growers at farmers' markets. A number of different beta-glucans and other cell wall polymers have a soothing and beneficial effect on gastritis and ulcers and can offer protective benefits for liver health. Diterpenes in the cultured mycelium, especially one called erinacine A, is a hot topic of research because of its ability to support nerve repair in the body and protect the mind and memory.

OVERVIEW OF POTENTIAL BENEFITS

Nerve support and repair (for neuropathies, pinched nerves, or nerve injury)
Mood regulating
Memory/cognitive function
Counteracting gastritis
Antibiotic
Anticarcinogenic
Anti-inflammatory
Antioxidant
Blood sugar regulating
Blood pressure lowering

Hericium erinaceus

Summary of Research Findings

The main biological activities and reported health-promoting properties of the fruiting bodies and mycelium are antibiotic, anticarcinogenic, antidiabetic, counteracting fatigue, lowering blood pressure, regulating cholesterol, and counteracting stomach inflammation (gastritis). Anti-inflammatory, antioxidant, and immune-stimulating properties are associated with oral doses of lion's mane as well. [34] Diterpenes, triterpenes, beta-glucans, fatty acids, GABA, and others are the most recognized and studied active compounds responsible. [35]

In addition to these other benefits, early trials have indicated that lion's mane appears to have neuroprotective properties. Improvement of anxiety, cognitive function, and depression has been shown in some small clinical trials and in vivo studies. Neuroregenerative effects are demonstrated in animal studies and in human cell lines.

What Makes It Medicinal

BETA-GLUCANS. Researchers have identified 35 bioactive polysaccharides in lion's mane, particularly some unique beta-glucans. These cell wall components are in high concentrations and have antitumor and immunomodulation, anti–gastric ulcer, neuroprotection and neuroregeneration, antioxidation and hepatoprotection, antihyperlipidemia, antihyperglycemia, antifatigue, and antiaging effects according to many laboratory studies. [36]

DITERPENES. In laboratory studies, these and other active chemical compounds have demonstrated a wide range of biological activity, helping to prevent or alleviate symptoms and diseases such as various cancers, gastric ulcers, diabetes, and blood lipid disorders, plus offering antiaging and antifatigue effects.

THE DITERPENES RESPONSIBLE FOR NERVE GROWTH

Modern research has focused on specific diterpenes called hericenones and erinacines. Found only in the fruiting bodies (not the mycelium), hericenones are being researched for their effects on stimulating nerve growth and relieving the symptoms of mood disorders. Erinacines, which are found only in the mycelium, promote positive nerve and brain health. Of the two, the erinacines seem to have greater benefits for slowing the aging process of the mind, helping to preserve memory, and stimulating nerve growth factor — perhaps helping to grow and repair nerve tissue. The research also shows that erinacines from mycelium are typically three to six times more potent than hericenones, offering another support for the use of fruiting bodies and mycelium together for nerve support. [37]

Laboratory Studies and Clinical Trials

Many laboratory studies and a few clinical trials with lion's mane products have focused on their protection against stroke, Parkinson's disease, Alzheimer's disease, depression, neuropathic pain (as in diabetes), early dementia, nerve damage, and gastritis and repair of gastric ulcers. [38]

So far, the results of four human clinical trials involving lion's mane are available on PubMed and on CNKI (the largest Chinese biomedical database). In one of these trials, a double-blind, placebo-controlled trial, the 30 male volunteers, ages 50 to 80 with mild cognitive impairment, took 1 gram of the powdered fruiting body a day for 16 weeks (approximately three or four capsules of the dry fruiting body twice daily). The cognitive functioning of volunteers who took lion's mane increased significantly over those taking a placebo, as determined on a cognitive function scale that measures memory performance. [39]

In a similar controlled study, 31 participants volunteered to take 1.6 grams of powdered fruiting body of lion's mane, twice daily for 12 weeks. The researchers measured cognitive performance by three standard tests. Those receiving the lion's mane had significantly better cognitive functions on the memory tests, compared with those taking a placebo, and this result held up over the course of the study. [40]

In another study, lion's mane reduced symptoms of depression and anxiety in a randomized, double-blind, placebo-controlled study with 30 women. The lion's mane group had significantly better scores. [41]

An early study showed some effectiveness for reducing symptoms of chronic atrophic gastritis (chronic inflammation of the lining of the stomach), likely due to the polysaccharide

compounds in the cell walls of the mycelium.[42] In a newer controlled study in China with 165 patients with chronic gastic ulcers, people took either rabeprazole sodium plus amoxicillin (the conventional medical treatment) or lion's mane extract granules. Those receiving the lion's mane product had as good or better stomach lining repair, reduced inflammation, and better quality of life scores compared to those taking the standard drug treatment.[43]

ABOVE: Wild lion's mane (*Hericium coralloides*) is also known as bear's head mushroom. It is delicious, and has a texture like crab when cooked.

Traditional Uses

In China, medicinal foods are made from lion's mane, and a number of products — typically powdered extract in jars, as well as packaged foods like drink mixes and bars — are widely popular. The powders are added to food during cooking, stirred into warm water and drunk as tea, added to smoothies, eaten, or taken as capsules. They are mentioned in traditional Chinese medicine as *hou tou gu*, recommended for strengthening the five internal organs, promoting good digestion, general vigor, and strength, specifically for gastric and duodenal ulcers and chronic gastritis. Lion's mane products are approved by the Chinese government as a medicinal food supplement where some claims can be made.

Dosage

Two "00" capsules (500 to 600 mg, or 1 teaspoon) three times daily of the dried tea powder or powdered extract for maintenance and treating mild symptoms; or 3 to 15 grams/day of the dried fruiting body in cooked medicinal dishes (a medium-sized fresh fruiting body).

What to Look for in Commercial Products

Dried lion's mane fruiting bodies are packed in plastic bags and widely sold in traditional Chinese grocery stores and herb stores, though they're not usually grown organically. They can be purchased from growers in the United States, some of which follow organic practices (see Resources). Capsules are widely available, but make sure to do the iodine test (see DIY Beta-Glucan Testing); if the mycelium is grown on grain, the product may be high in starch and low in the active compounds. I have tested a number of them, and that is what I've found. Look for capsules that guarantee diterpene (or erinacine A) content. Remember: A guarantee of a certain percentage of polysaccharides means nothing because starch is a polysaccharide.

ABOVE: In the wild, lion's mane commonly grows on oaks and other hardwoods.

Identification in the Wild

HABITAT. In my area of central California, I see fruiting bodies every fall and early winter growing on downed oak trees, typically around Thanksgiving. In areas of the country with freezing winters, such as the eastern United States, look for them on hardwoods in August through early November.

ID TRAITS. Lion's mane is unmistakable, looking like white coral or densely packed stalactites in a large clump. Masses of thin branches hang down on the outside of the "bear's head" (a name applied to other species of *Hericium* as well), but inside it is dense with a few channels or small pockets.

LOOK-ALIKES. Nothing else really looks like it, except for other species in the genus such as *H. coralloides*. Cauliflower mushroom (*Sparassis crispa* in the eastern United States and *S. radicata* in the West) is a similar color and has a similar texture. *Sparassis crispa* grows at the base of pines or other conifers and has masses of overlapping wavy, tender scales, while *S. radicata* grows at the base of hardwoods. These species are also edible and delicious and have some medicinal benefits, such as wound-healing and antitumor properties. [44]

ABOVE: *Sparassis crispa* (an edible lion's mane look-alike)

ABOVE: Cultivated lion's mane isn't as dramatic as the large, wild specimens, but it has very similar benefits.

Harvesting, Processing, and Using

Lion's mane fruiting bodies can be eaten in a number of different ways. Very large ones can be sliced and sautéed until tender, broiled, baked with a marinade, or added to soups. They are as delicious as they are healthful!

The diterpenes (which benefit the nerves, mood, and memory) are alcohol soluble, so making a tincture of the dried fruiting bodies makes sense because it will have these important active compounds in abundance. A tincture with 80 percent ethanol and 20 percent water can work well. The dose for this preparation is ½ to 1 teaspoon twice daily. This is a good species for the double-extraction method, which balances the content of beta-glucans, diterpenes, and other important compounds.

I recommend making a tea extract powder to concentrate the active diterpenes, which only occur at about a half a percent of the dry weight. Follow the directions for making a dried tea extract in the step by step, but boil it down so that the liquid is reduced by a ratio of 10:1 before the extract is dehydrated. By doing this, the resulting extract will be 10 times higher in diterpenes.

MAITAKE

Grifola frondosa

The currently accepted name was first published by Samuel Frederick Gray in 1821.

OTHER NAMES: Hen of the woods, sheep's head, *hui shu hua* (Chinese, meaning "gray tree flower"), *Klapperschwamm* (German)

Maitake ("dancing mushroom" in Japanese) is a polypore mushroom that is often sought out for its delicious flavor and texture. It's revered in Asia (particularly in Japan) for its healing effects, especially for its nutrient content and immune-activating, blood-sugar-regulating, and antitumor properties. Maitake is commonly found in the wild, but it's also one of the most widely cultivated mushrooms, along with the button mushroom, shiitake, and oyster mushroom. It tastes fantastic, and it has a number of health benefits that are supported mainly by preliminary animal studies and a few small clinical trials.

OVERVIEW OF POTENTIAL BENEFITS

Cancer support programs

Antioxidant

Liver protective

Cholesterol regulating

Enhances immune function

Lowers blood glucose levels

Grifola frondosa

Summary of Research Findings

Maitake contains vitamin D and a high amount of B-complex vitamins, and it comprises about 40% usable protein, 15% fiber (or more), 8% fats, and 9% minerals, especially potassium. [45] It has about 26% beta-glucans; various beta-glucans have been isolated from maitake and studied, including one called grifolan. Thirteen animal studies showed grifolan to have immunomodulating effects on antibody and cytokine production and anticancer effects. [46] Another extract of maitake is D-Fraction — a product in which a specific and intensively researched beta-glucan is concentrated to increase the potency of immunomodulation and anticancer effects. [47] Maitake D-Fraction products are available in the United States.

As with many other fungal species, maitake contains significant amounts of biologically active phenolic compounds (antioxidants), nucleotides, and lectins. [48]

Five clinical trials with maitake, three of them randomized, and more than 130 animal studies (in vivo) and laboratory studies in test tubes (in vitro) have been published. The laboratory and in vivo studies support maitake's ability to reduce blood sugar; reduce total cholesterol levels; enhance memory; provide antidepressant, antitumor, and antiviral effects; and modulate the immune system. The immunomodulating effects in humans were a result of maitake's ability to boost the functioning of neutrophils and monocytes, two important immune effector cells that help protect us against pathogens and that can be suppressed by chemotherapy and radiation therapy as well as by the presence of active cancer in the body. Researchers reviewing the

evidence of maitake's clinical benefits concluded that the three most studied and supported uses are for cancer, diabetes (blood sugar control), and immunostimulation. [49]

Animal studies — such as those used in the testing of D-Fraction — don't necessarily translate into clinical benefits, but they are a starting point for the development of human clinical trials, as well as for partially explaining how some of the traditional uses work. [50]

Traditional Uses

In Japan, maitake is a common remedy for arthritis, hepatitis, and immune deficiency conditions, as well as in cancer support programs and for cancer prevention. Products from maitake are also popular for helping to regulate the body's insulin functions and regulate blood sugar.

A review article on maitake reports that maitake was used in traditional Chinese medicine for strengthening the digestion and the immune response, to "moisten the lungs," and to protect the liver. [51] Other sources say that maitake was used in traditional Japanese Kampo medicine to treat stomach, heart disease, hemorrhoidal, and nervous system conditions.

Dosage

Traditional doses range from 1 to 6 grams/day of the steamed and dried processed commercial powders, or the dried tea powder made at home. Six to 20 grams of the dried fruiting body can be made into tea and consumed per day. Two to three droppersful (2 to 3 mL) of tincture can be taken once or twice daily. Several ounces of fresh mushroom can be cut up and stir-fried or eaten in soups.

What to Look for in Commercial Products

One Japanese company has been promoting the beta-glucan fraction (a group of isolated chemicals with similar molecular structures and solubility) of maitake as different from those of any other mushroom, branding it D-Fraction. They sell it in liquid form and in capsules, and they have sponsored a number of laboratory studies that showed D-Fraction had a suppressive effect on hepatitis B as well as immune enhancement, particularly on natural killer cell effectiveness for killing cancer cells in animals and humans. Independent research will help verify their results.

Identification in the Wild

HABITAT. Maitake is often found in late summer or fall in the eastern United States and in many European and Asian countries. It fruits on the lower trunks and roots at the base of maples and other hardwoods.

ID TRAITS. Fruiting bodies are often on or not far from the ground, attached to dead or dying hardwood trees or roots, and are composed of small, spoon-shaped overlapping caps that can form rosettes, with a solid base. Large ones can weigh up to 50 pounds. They are white, buff-colored, tan to brown, sometimes with zoned areas of lighter and darker colors on the caps. I've occasionally seen ones with a lavender tint. The bottom of the caps has many tiny pores, and is white and textured; it feels rough when you run your finger along it. The smell is mild and pleasant, and the taste is slightly sweet and

mild, not usually bitter. The mushroom should be soft and tender, especially when young.

LOOK-ALIKES. This is a unique polypore; there's nothing quite like it. As with any mushroom, though, be sure to examine your wild specimen carefully and note a number of the distinctive identifying characteristics listed above before consuming it.

Harvesting, Processing, and Using

When only one medium-size or massive fruiting body is in the area and no others are seen, I recommend taking only half of it home to cook — leaving half of the base still attached. That way, the remaining portion can disseminate its spores. If a number are around, take one and leave the rest. It's so exciting to find one maitake that it is tempting to grab it all; I've been guilty of this myself. But it's important to respect the beauty and web that is the forest, and to practice gratitude and moderation when taking fruiting bodies. Leaving some behind to produce spores means maitake is more likely to be there when we come back next year.

Maitake has been widely cultivated in Japan since the mid-1980s and is now available in many markets throughout the United States. Some people have experienced GI distress after eating it, so be sure to cook it well and try just a small amount the first time.

DANCE OF THE MUSHROOM

Maitake comes from the Japanese word *mai* meaning “dance,” and *take*, for “mushroom.” Some say that people danced with joy when they found it, or perhaps the overlapping and alternating small caps reminded one of dancers.

Not long ago, I was attending a small conference in the northeastern United States, where maitake is common in fall at the base of oaks, maples, and other hardwoods. I was walking along a wonderful trail through the leafy forest, looking for any mushrooms that caught my eye. Instinctively, I suddenly thought to turn to the right, off the trail and over a rise. Going up over the rise and around a few trees, I saw it: a giant maitake growing on the base of a hardwood stump, and in perfect shape, no less.

At the time, I did dance for joy because I was so excited to share my find with the rest of the conference participants. Another slightly smaller one was growing on the next stump over, so I picked the big one, which was perhaps a little more than my share. It felt right, though. In the kitchen of the lodge where we were staying, I sliced and washed the duff and leaves out of the mushroom, sliced it into smaller pieces, and sautéed it with olive oil and a bit of salt on a big grill. It smelled fantastic. Going around the dining hall and serving a sample to all 50 people was the highlight of the conference — so many sounds of delight reached my ears, and my heart.

OYSTER MUSHROOMS

Pleurotus ostreatus and other species like *P. citrinopileatus* (golden oyster), *P. salmoneostramineus* (pink oyster), *P. eryngii* (king oyster)

The current name of the most widely cultivated and common wild species, *Pleurotus ostreatus*, was first described by Paul Kummer in 1871.

OTHER NAMES: *Hiratake* (Japanese), *ping gu* (Chinese), *Austernseitling* (German)

Mushrooms in this genus are the third most commonly cultivated species in the world, after the button mushroom and shiitake. These are among the best edibles, with high protein content (some species have up to 35 percent protein), high digestibility, high fiber, high mineral content, and 15 to 20 percent beta-glucans. They also have mild immunomodulating effects and have been studied in small clinical trials and other animal studies showing a cholesterol- and blood-sugar-lowering effect.

OVERVIEW OF POTENTIAL BENEFITS

Immunomodulating

Cholesterol and blood sugar lowering

Pleurotus salmoneostramineus

Summary of Research Findings

Clinical research on *Pleurotus* species is not abundant, but a few studies are worth mentioning. Remember that these studies are preliminary because of the small sizes, but they do point the way for larger studies or even experimentation with oyster mushroom dried tea powder for providing a blood-sugar- and insulin-normalizing benefit, a cholesterol benefit, and to reduce the inflammation of dermatitis.

Human Studies

In one study, 80 volunteers with mild to moderate atopic dermatitis experienced an improvement in both subjective and objectively evaluated symptoms, such as inflammation and itching, and the days of active symptoms were shortened, after applying a cream containing beta-glucans extracted from oyster mushroom. [52]

Another study showed that when 44 volunteers with type 2 diabetes ate 3 to 4 grams of freeze-dried and powdered oyster mushrooms, followed by 75 grams of glucose in 300 mL of water daily for 2 weeks, blood sugar levels declined 15 to 16.5 percent compared with controls, and insulin levels increased by 21 to 22 percent. [53]

Two studies demonstrated that the beta-glucan fraction from oyster mushrooms (pleuran beta-glucan) had immunomodulating, antiallergic, and anti-inflammatory effects in children with recurrent respiratory tract infections. [54] Two more studies determined that

supplementation with pleuran beta-glucan extracted from oyster mushrooms had a positive effect on cellular immunity when given to elite athletes. [55]

Natural Statins

Interestingly, this mushroom contains a closely related molecule to lovastatin, a statin medication prescribed to lower cholesterol in the body. The mushroom version is quite mild, though; studies show that it would take about 4 ounces of the powder daily to bring cholesterol levels down by 10 percent. However, consuming the fresh mushrooms or powdered extract frequently could help lower your cholesterol and protect the lining of your blood vessels because of the amount of fiber mushrooms contain, in addition to their anti-inflammatory effects. That said, these benefits are mostly theoretical in humans and based on a number of animal studies. [56]

ABOVE: Young tree oysters on a cultivation block

KING OYSTER

Pleurotus eryngii

Traditional Uses

There isn't much information about the historical uses of *Pleurotus* species, but it was noted in fourth-century China that the beautiful mushrooms were called the "mushroom flower of heaven." [57] Indeed, I have marveled at their beauty when sprouting from a standing dead oak tree.

ABOVE: Clockwise: GOLDEN OYSTER *Pleurotus citrinopileatus,* PINK OYSTER *Pleurotus salmoneostramineus,* TREE OYSTER *Pleurotus ostreatus*

Dosage

For health benefits, eat one or two cooked fruiting bodies two or three times a week, at least. For cholesterol and blood glucose benefits, use 3 to 4 grams of the dried and powdered fruiting bodies, or about 800 mg of a dried tea extract. This would amount to ½ to 1 teaspoon.

What to Look for in Commercial Products

You can purchase several different species of *Pleurotus*: Some are yellow, pink, gray, or white. The king oyster is big and stout, with a long, thick central stem. All are widely available at specialty groceries and farmers' markets. They have excellent flavor and texture once cooked. They are also easy to grow at home, on logs or in sawdust, and spawn for all of the cultivated species are available for home growing. (What a beautiful and exciting picture to see the many-colored oysters growing in your kitchen!) Products in capsules may consist of mushroom mycelium grown on various grains. Product quality and beta-glucan content will vary.

Identification in the Wild

HABITAT. *Pleurotus ostreatus* grows on hardwoods — especially deadwood, either standing or lying on the ground — and is common throughout the Northern Hemisphere. These are

early-season mushrooms. In the Bay Area of California, they can be found in October, sometimes even before the first rains, on alder logs near streams, on oak, and on cottonwood. I have also seen them on coast lupine bushes in northern California.

ID TRAITS. The fruiting bodies typically form in clusters, rarely one or a few by themselves. The stems are typically lateral and stubby (not coming out of the middle, but off to the side), rarely central if they are growing out of the top of a log. At first, they are very white, slate gray, or tan to slightly brown, but then turn yellowish buff to yellow, finally drying to darker colors as they age. The color can be darker, sometimes bluish when the caps are exposed to a significant amount of sun. The caps are slightly firm but easily broken — not tough. To me the fruity smell, mild taste, clustered position on downed or standing dead oaks or other hardwoods, lateral stem, and white to slightly lilac spore print are all characteristic and diagnostic.

LOOK-ALIKES. Oyster mushrooms always grow on wood, so that eliminates other white mushrooms that can be toxic like *Tricholoma* species, *Amanita* species, and some species of *Agaricus*. *Clitocybe* is a genus of white-capped mushrooms that grows on wood, but the caps are small and round, with long stems that are central on the cap. *Pleurocybella porrigens*, commonly known as “angel wings,” is another look-alike, but it only grows on conifers (whereas oyster mushrooms grow on hardwoods). Unlike the three mentioned genera above, oyster mushrooms should smell fruity and inviting and have lateral stems.

Harvesting, Processing, and Using

Specimens should be somewhat firm and not wormy. If they are flaccid or have started to melt, reject them. By the time they are yellow, they often are a bit past their prime. Make sure to smell the tops of the caps for mold or other odors that are not pleasant. Taste a small piece of the cap, which should be fairly bland perhaps with a hint of bitter, but not noticeably bitter or acrid. Some people have reported having allergic reactions to oyster mushrooms, so start with just a small taste of cooked mushroom.

ABOVE: *Pleurocybella porrigens* (bottom) looks similar to some groups of oyster mushrooms, such as *Pleurotus ostreatus* (top). Unlike oysters, which grow on hardwoods, "angel wings" grow on conifers. They typically have an inrolled margin, thinner flesh, and fruiting bodies that do not smell fruity like the oyster mushroom does. They should not be eaten.

REISHI

Ganoderma lingzhi, *G. sichuanense*, *G. oregonense*, *G. tsugae*, and other *Ganoderma* species

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The current accepted Latin name for *G. lingzhi* was first published by Sheng H. Wu in 2012 and confirmed by further research. [58]

OTHER NAMES: *lingzhi* (Chinese; pronounced *ling-zhir*), lacquered polypore, mushroom of spiritual potency

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Reishi is the Japanese name for a shiny-capped, long-stalked polypore that has captured the imagination of people for at least two thousand years. The genus, which includes what I call reishi-like mushrooms, is *Ganoderma*, which means "shiny skin," due to its lustrous orange, yellow, red, or black cap. Reishi is the leading seller within the medicinal mushroom category of dietary supplements, and for good reason: It has so much to offer. It is widely cultivated in Asia and is a very popular product shipped to the United States.

OVERVIEW OF POTENTIAL BENEFITS

A list of the biological effects of reishi that have been proven through in vivo and in vitro studies 59 reads like something of a panacea:

- Benefits the heart and helps regulate cholesterol, blood pressure, and blood sugar levels
- Retards viral growth
- Reduces inflammation and helps protect against free radicals and tissue damage
- Activates immune function
- Inhibits tumor growth
- Relieves pain
- Protects the liver
- Relieves symptoms of anxiety, insomnia, and depression
- Improves cognitive function
- Improves energy
- Benefits the lungs and respiratory tract

Ganoderma oregonense

Summary of Research Findings

Research interest in reishi has increased rapidly in the past 18 years. In 2002, 185 research articles were published on reishi--like fungi as the primary focus. By 2020, that number had increased to more than 800 articles. To date, clinical trials of good quality are few but growing rapidly. However, more research is needed to confirm the effective dose, species, type of extract or powder, and duration of use. Both water-based extracts (tea and dried tea powders) and ethanolic extracts (tinctures) seem to be the most effective preparations.

Leading the human studies is the ability of reishi to activate the immune response against cancer cells in the body, followed by diabetic treatment, liver protection, neuropharmacology and psychotherapy, cardiovascular protection and treatment, and treatment for chronic respiratory tract infections and inflammatory conditions like chronic obstructive pulmonary disease (COPD).[60] For immunomodulation, studies focus on various beta-glucans, immunomodulation proteins, and the triterpenes from both *Ganoderma lingzhi* and *G. tsugae*.

Cancer Immunotherapy

Cancer immunotherapy is one of the major ways reishi and its preparations are utilized, but few clinical trials or human studies are available outside of China. Still, reishi is widely used in cancer support programs, and many animal studies clearly show antitumor as well as immunological effects.

In one study, 96 patient volunteers taking 1.5 grams/day of a reishi-like mushroom extract for 12 months had a decrease of about 40 percent in the size of precancerous adenomas in the colon (based on colonoscopies) compared with an increase of about 73 percent in those receiving a placebo.[61] Another research group found that 30 out of 34 patients with advanced-stage lung cancer who took 1,800 mg of a water-based extract with purified beta-glucans (equivalent to a hot water extract of 81 grams of fruiting body) three times daily for three months experienced a significantly increased immune response, particularly an increase in natural killer cell activity.[62]

In a Cochrane Systematic Review and meta-analysis on reishi treatment for cancer, researchers reviewed all clinical studies and identified one study in English and four in Chinese that met their stringent requirements for methodology and reporting. These studies comprised 85 patients and included positive results for patients with lung cancer. When combined with chemotherapy, those receiving reishi generally had a more favorable response, by about 25 percent. Key immune responses were also higher in four of the five studies, and patients reported a better quality of life during treatments.[63]

ABOVE: In China, *Ganoderma sichuanense* is revered and thought to be more potent than other species because of its size.

Cardiovascular Risk Factors and Diabetes

Research on the benefits of reishi for prevention and treatment of cardiovascular disease and blood sugar imbalances is still in the beginning stages; more high-quality

research is needed. However, reishi supplementation for cardio benefits is commonly practiced in Asia, and the preliminary studies with humans are encouraging. Along with hawthorn leaf and flower extract, reishi is one of the top herbal supplements recommended for patients with high risk factors, such as family members that developed cardiovascular disease.

A number of animal studies, studies using human cells, and human clinical reports (mostly from China) show that reishi cell wall components (a polysaccharide peptide complex, and other extracts) have a cardioprotective effect. [64]

In a comparative human trial, 37 high-risk and 34 stable angina patients took 750 mg of a polysaccharide peptide (180 mg beta-D-glucan) complex from *Ganoderma lucidum*. Levels of antioxidants in the blood of patients in both groups increased, while risk factors for damage to the endothelial lining of the blood vessels, a major determinant of the progression of atherosclerosis and heart disease, were improved. [65]

Some existing studies focused on clearly determining the cardiovascular benefits of reishi show a lack of quality control, however. The mushroom species was often not reported, nor was whether the product contained mycelium or fruiting bodies, whether the cell wall fiber was included in the product, or whether the extracts contained maltodextrin, starch, or other fillers, binders, and excipients.

In one current systematic review, researchers evaluated five clinical trials with a total of 398 participants to determine whether reishi affected cardiovascular risk factors such as total and LDL cholesterol levels and HbA1c (a measure of long-

term blood glucose levels). The dosages were in the range of 1.4 to 3 grams/day of an extract (in one, 2.24 grams of a 10:1 extract plus 750 mg of spores and 700 mg of excipients) over 12 to 16 weeks. No benefits were seen compared with placebo, and side effects were similar to placebo. [66] Notable in these studies is the lack of the original mushroom fiber in the preparations and the lack of beta-glucan testing. Additionally, the reishi 10:1 extract itself could have included a significant amount of starch or maltodextrin.

> Reishi is high in fungal beta-glucans — the most widely studied component of medicinal mushrooms for cancer immunotherapy.

Liver Inflammation

In one study, consumption of *Ganoderma lucidum* extract (225 mg/day in 21 patients, with 21 receiving a placebo) enhanced levels of antioxidant enzymes in the blood and significantly reduced hepatic markers for liver stress or inflammation, such as GOT and GPT. [67] These liver enzymes are often elevated when the liver has to deal with toxic substances such as chronic acetaminophen use, or with infections such as hepatitis. Further, ultrasound tests showed a reduction in liver size, and the authors report a reversing effect in mild fatty liver conditions of some of the patient volunteers. Even better results might be achieved with a more traditional dose of 1

gram, twice daily (rather than the 225 mg/day used in the study).

Neurasthenia

A randomized, double-blind, placebo-controlled study was conducted with 123 patient volunteers who had a diagnosis of neurasthenia, based on an international classification. *Neurasthenia* is a general term for a stressed-out or weakened nervous system condition with symptoms like fatigue, headache, irritability, and sometimes with other mood-related symptoms like depression. About half of the patients received 1,800 mg three times daily for eight weeks, while the other half received placebo pills. No one, including the researchers, knew who was getting the reishi. After eight weeks, meaurements on the Clinical Global Impression (CGI) improvement of severity scale and the Visual Analogue Scale for the sense of fatigue and well-being had improved 51.6 percent in the reishi group compared to 24.6 percent in the placebo group, [68] a significant difference.

COMBINING MUSHROOMS FOR CONTROL OF HPV

One study showed the potential of combining reishi and turkey tail for controlling oral human papilloma virus (HPV). Out of 472 patients who received oral swabs for gingivitis

during routine dental exams, 61 were positive for HPV 16 or 18 (the two highest risk types). One group of 41 patients took an extract of sulfur shelf mushroom (*Laetiporus sulphureus*), and a second group of 20 took a combination of turkey tail and reishi for two months.

In group 1, the viral clearance was 5 percent, and in group 2 (receiving the reishi plus turkey tail), it was 88 percent. [69] In this case, it is impossible to determine whether the main effects were from turkey tails or reishi, or both, so it seems advisable to take them both together for this use.

Physical Fitness in Women with Fibromyalgia

Reishi-like mushroom supplementation (3 grams of a leading European brand of organic bitter reishi mycelium micropowder dissolved in water and taken twice daily) significantly improved aerobic endurance and lower body flexibility in women with fibromyalgia compared with a placebo group receiving carob powder. [70]

Blood Coagulation

One study showed promise for refuting a common theory that patients should avoid using reishi before and after surgery or with blood thinners. In the study, 20 healthy volunteers received 1.5 grams of reishi powder and 20 received a placebo

daily for eight weeks. Subjects from both groups were monitored at four and eight weeks with a routine coagulation screen. No significant differences were noted in coagulation between the two groups. [71]

Traditional Uses

Reishi is a Japanese name for useful species of *Ganoderma*. Traditionally it was hung in the entranceway of the home to help keep bad spirits from entering. It was also associated with good luck when marrying and kept in the home. The best reishi was said to grow on plum trees. [72]

Called lingzhi, reishi has been known in Chinese medicine as the divine mushroom because of its strong action to protect and help heal the spirit as well as the body. It was recommended to calm the spirit and augment the heart qi. According to the Bencao Gangmu (the most famous Chinese herbal; see here), the ancients were said to become immortal when they ate reishi. When they found it, they would eat it fresh, right away. *Zhi* (which in some situations means "crooked" in China) was first used to refer to the tree that reishi fruiting bodies grew on. Likely different species of *Ganoderma* had different colorations. Later, all edible species of *Ganoderma* were known as zhi. *Ling* could refer to "the mountains," where lingzhi was harvested.

The first written mention of lingzhi in Chinese traditional medicine was in the book *Divine Husbandman's* or *Divine Farmer's Classic of Materia Medica* (called the Shennong Ben

Cao Jing), dating from 200 to 250 CE and based on even earlier oral tradition.

ABOVE: This specimen of *Ganoderma sessile* was growing on maple tree roots in Georgia.

A Different Species for Every Organ

In the Bencao Gangmu, at least five different types of lingzhi are written about: yellow, white, black, purple, and red. They relate to the five elements (wood, fire, earth, metal, and water) and five internal organs (kidneys, lungs, liver, spleen, and heart). The different colors correspond to different species of *Ganoderma* that could be commonly found in the mountains and forests of ancient China. [73]

For example, because of its color, black reishi (*G. sinense*) was thought to be more effective for symptoms associated with the kidneys (as defined in traditional Chinese medicine), such as treating deafness. Other uses are similar to red reishi for immune weakness, for cancer programs, and as an anti-inflammatory to treat pain and soreness of arthritis. I have found this to hold true in my clinical and personal experience over the years. Although the colors described by the ancients don't all exactly match up, some do: heart = red, kidneys = black, yellow = liver/gall bladder.

The color of any given reishi species can change, too, depending on weather conditions and time of year; for instance, red can change to yellow or orange. The appearance of reishi-like mushrooms, then, is not always a good gauge of species identity. That's why the taxonomy and accepted Latin names are more settled now after DNA sequencing became widely available in the late 1980s and early 1990s.

Trying to match up species of *Ganoderma* today with those used in ancient Chinese medicine requires further study. It's clear, though, that different species have different profiles of triterpenes and likely have somewhat different branching

patterns of beta-glucans, along with varying amounts of phenolic compounds and other low-molecular-weight compounds. Thus the activity and uses do vary between species.

It is interesting to note, however, that the range of colors mentioned in the Bencao Gangmu can be seen in various reishi-like mushrooms found today. In my own travels, I have come across reishi-like mushrooms that were nearly pure yellow, some that were pure red, black, white, almost purple, and some in shades of brown.

The hemlock mushroom (*G. tsugae*) is known as *song shan ling zhi* (pine tree fungus) and is traditionally used for protecting the liver and many of the functions of red reishi, though is supposedly not as effective for treating mood disorders and insomnia. This species grows widely in the United States and ranges in color from red to orange to yellow.

Modern students of traditional Chinese medicine refer to the authoritative compilation *Chinese Herbal Medicine: Materia Medica,* by Dan Bensky and colleagues, which summarizes the most common uses of reishi in Chinese medicine, including:

- Calms the spirit (for anxiety, nervousness, nightmares, restless sleep)
- Strengthens the heart blood (normalizes blood lipids, brings more blood to the heart muscle, reduces palpitations, used regularly to protect the cardiovascular system generally, offers antioxidant effects)

- Strengthens lung functions, helps dissolve phlegm and congestion; recommended for coughing and wheezing, especially for people with white, sticky mucus congestion, not active infections; excellent when used regularly for preventing and treating chronic allergic rhinitis and other chronic respiratory tract ailments like asthma and COPD, along with healthy habits and other treatment modalities (acupuncture, diet therapy, stress management, mindfulness)
- Serves as a general tonic for the respiratory tract and cardiovascular system, for shortness or breath and lack of appetite. Use a bitter reishi to enhance digestive ability and assimilation of nutrients.

In the early Chinese reference, *The Classic of Herbal Medicine*, written between 200 and 250 CE, red reishi is lauded: "Long-term use of lingzhi makes one feel happy and vigorous and able to enjoy a long life like an immortal." Our immune function is essential for maintaining energy, vitality, and a serene mood.

THE BENCAO GANGMU: A CHINESE HERBAL TREASURE

The Bencao Gangmu, also known in English as the *Compedium of Materia Medica*, comprises five volumes and is the compilation and summary of a significant portion of the historical record of China's herbal medicine lore and

uses. Compiled by Li Shizhen and completed in 1578, it is a cultural treasure and is still the most complete work of Chinese traditional herbal materia medica (compendium of medicinal substances) ever written. The complete work has only recently become available in English.

Dosage

For most conditions, such as respiratory tract inflammation, fatigue, chronic insomnia, anxiety, and other mood disorders, start with 2 to 3 grams of the cooked, dried, and finely powdered fruiting body of reishi-like mushrooms twice daily in tea, or 1 to 2 grams of the tea concentrate. For health maintenance as a daily supplement, 1 gram/day of the tea

concentrate is sufficient, or 1 to 2 grams of a steamed mycelium or fruiting body product, depending on its beta-glucan and triterpene content. The beta-glucan content should be between 15 and 35 percent.

ABOVE: Cutting fresh reishi into slices makes it easier to dry and powder.

What to Look for in Commercial Products

LOOK FOR *GANODERMA LINGZHI* ON THE LABEL. Wild species can be used for medicine, but because of the chemical variability in different strains of the same species — as well as in different species growing on particular trees in widely differing habitats — it is difficult to say that one is better for lungs, another better for the cardiovascular system, and yet another for insomnia and anxiety because they haven't all been tested side by side in humans. My experience tells me that most reishi-like species will have some of the traditional effects, but I still recommend using the red reishi most commonly found in the trade and in Chinese herb shops, *G. lingzhi*, as a starting point (unless you have access to wild species locally). I recommend buying bulk mushrooms from the suppliers listed in the Resources because they are less likely to be fumigated and contaminated with pesticides. As with many other mushroom products, fruiting bodies are cultivated in China, and mycelium products are mostly produced in the United States. This is simply because fruiting body production takes extra time and is more labor intensive, and labor is far less expensive in China than it is in the United States.

If species other than *G. lingzhi* are used in products, the correct species has to be listed in the ingredients panel by law, preferably confirmed by both DNA and chemical analysis. The problem with purchasing reishi products and reishi fruiting bodies is that the exact species identity is often not confirmed by modern methods of analysis. Many products still say *Ganoderma lucidum* in the ingredients panel when the product is likely to be *G. lingzhi*, *G. sichuanense*, or perhaps other species traded in Asia. If you want better assurance about what

species is in the product, call the manufacturer and ask if they have performed DNA and chromatography to confirm the species.

TESTED FOR PURITY AND BETA-GLUCANS. Reishi is often grown on cooked rice, sawdust, or other media, so the product should have a verified level of fungal beta-glucans. I would like at least 10 to 20 percent fungal beta-glucans in any reishi product I use. If it has this amount, then I would assume it also has the beneficial triterpenes. The product should also be tested for species identity and purity (no mold contamination, for instance). At some point in the future, hopefully, products will also be labeled with guaranteed levels of individual triterpenes that have the highest biological activity, as well as further biological assays to show the amount and kind of immune stimulation, antioxidant strength, and anti-inflammatory activity.

MYCELIUM OR FRUITING BODY. Based on research, it's clear that mycelium is not less active per se than fruiting bodies, but fruiting bodies are usually higher in fungal beta-glucans — sometimes considerably higher. On the other hand, grain-cultivated mycelium can have ample amounts of triterpenes and fungal beta-glucans, if an aggressive strain is used and if the mycelium is allowed to consume all or almost all of the grain. Hence the need for a verified level of fungal beta-glucans.

Products that exclusively contain fruiting bodies are likely to be grown in China, where the labor-intensive process is less

expensive, and shipped to the United States (or extracted first, then shipped). To be cost competitive, almost all reishi mycelial products grown in the States are grown on grains. When it comes to the purity of the product and how it was produced, I believe there tends to be greater accountability for domestically grown reishi; the process is followed closely from start to finish. The quality of the water, air, wood, and other added nutrients can be confirmed more frequently when the manufacturer is also the grower and is not thousands of miles away.

BITTERNESS DOESN'T EQUAL POTENCY. Bitterness is not necessarily a good determinant of how potent a product is. Research shows that some triterpenes are bitter and some have little taste, so some reishi fruiting bodies and even mycelium-based products are bitter and some are not. However, one of the major companies of reishi products in Spain clearly advertises the bitter taste of their product as a quality and identity marker. For a reishi product, I would say that some bitterness is good and is an indication that reishi terpenes are present. However, if the product has been DNA tested and some standardization guaranteed of beta-glucans and/or terpenes, then the lack of bitterness is not an absolute sign of low quality.

Identification in the Wild

If you're seeking your own reishi-like mushrooms in the wild, you might run into several species, depending on your region. These are high in fungal beta-glucans and triterpenes.

However, the exact levels and identity of these important compounds vary between species. I hesitate to say they are exactly interchangeable, but I wouldn't hesitate to make dried teas and use the local species as you would *G. lingzhi*, expecting similar, but not exactly the same results.

ABOVE: These two fruiting bodies of *Ganoderma tsugae* from the East Coast (top) and West Coast (bottom) show the wide variation in the species.

FOUR *GANODERMA* SPECIES FOUND IN THE TRADE

SPECIES	TYPICAL APPEARANCE	NOTES
G. lingzhi	Small to medium-sized brick red caps covered by a dusty brown powder. Not typically stalked.	Most red reishi fruiting bodies in the trade are from cultivated sources in China, though there are a handful of organic producers in the United States as well.
G. sichuanense	Appearance widely variable; common in Asia; some are giant and completely round, found in Chinese herb shops.	Sometimes used as a substitute for G. lingzhi in products from China labeled “reishi” or “ling zhi.”

G. lucidum	Variable: red, yellow, purple; typically stalked.	All reishi-like lingzhi fungi used to be called Ganoderma lucidum before DNA analysis was available to separate additional species. Typical reishi-like fungus found in Europe, western Asia; rare or misidentified if found in the United States. DNA analysis necessary.
G. sinense	Typically dark black cap, stalked.	Often cultivated in Asia and available in Chinese herb shops in the United States as “black reishi.”

Source: Liao et al., 2015; Loyd AL, Richter BS, Jusino MA, et al., 2018.

HABITAT. *Ganoderma* is a widespread genus, comprising approximately 80 species worldwide. Several species of *Ganoderma* grow in North America and can be used similarly to *G. lingzhi,* including *G. oregonense, G. tsugae, G. curtisii,* and *G. sessile.* I have found and collected reishi-like mushrooms in a number of places, from a cactus in Mexico to thick slices of tree rounds in the Amazon laid down as a path through the jungle. I've collected them in California along the coast and even in the Sierra foothills, as well as in forests in the eastern United States.

The fruiting bodies are striking when seen growing on maple or other hardwoods. I once found a group of seven fruiting bodies on a dead maple tree in Pennsylvania, after going out of my way down a creek bank and walking a hundred feet along the creekside and around a large rock formation. The sight of them gave me a feeling of pure spirit and magic. I had no reason to go that way, but followed an intuitive feeling. I brought one of them with me and have it still. Perhaps I have developed a good feel for what kind of habitat they would be growing in, or perhaps it's some other kind of connection I have to take my scientist hat off to really believe.

ABOVE: Even though it's a species that naturally grows on wood, reishi can be cultivated on rice with great success, as evidenced by the number of fruiting bodies seen on this cultivation block.

LOOK-ALIKES. Once you get to know them, you'll realize that there's really nothing else that looks like reishi. There are no look-alikes. Reishi-like mushrooms are annuals; when young, even often when old, they are softer and spongier than perennial polypores (those that put on annual layers of pores where the current crop of spores are produced), which are woodier and thicker.

Harvesting, Processing, and Using

Harvest reishi with reverence! I like to imagine the ancients who wandered the beautiful mountains on their vision quests

or spiritual journeys and who were incredibly joyful and grateful to find one. Isn't gratitude part of the medicine? To show your gratitude (and to allow the fungus to spread its spores far and wide), always leave at least half of the fruiting bodies you find.

Freeze to Kill Larvae

After picking reishi-like mushrooms, take them home, clean off any dirt or duff, and let them dry naturally in a warm place with good airflow for a week or so. Then freeze them for three days to kill any fly eggs. If you don't, the mushroom will be eaten from the inside out. This advice also goes for reishi purchased in a Chinese herb shop.

Medicinal Preparations

I always have one or two fruiting bodies near my bed and in my office to bring in the wild lingzhi spirit. Any others, I turn into dried tea powders and keep them on hand year-round as a frequent supplement, increasing the dose during winter to help prevent infections.

For maximum immune action powdered tea extract, made at home or purchased from a reputable source, is best (see Resources). For maximum anti-inflammatory effects, the high-triterpene alcoholic extract or dried tea extract is likely best. I suggest the double extraction for easing stress as an adaptogen, as well as for sleeping and mood problems. You can

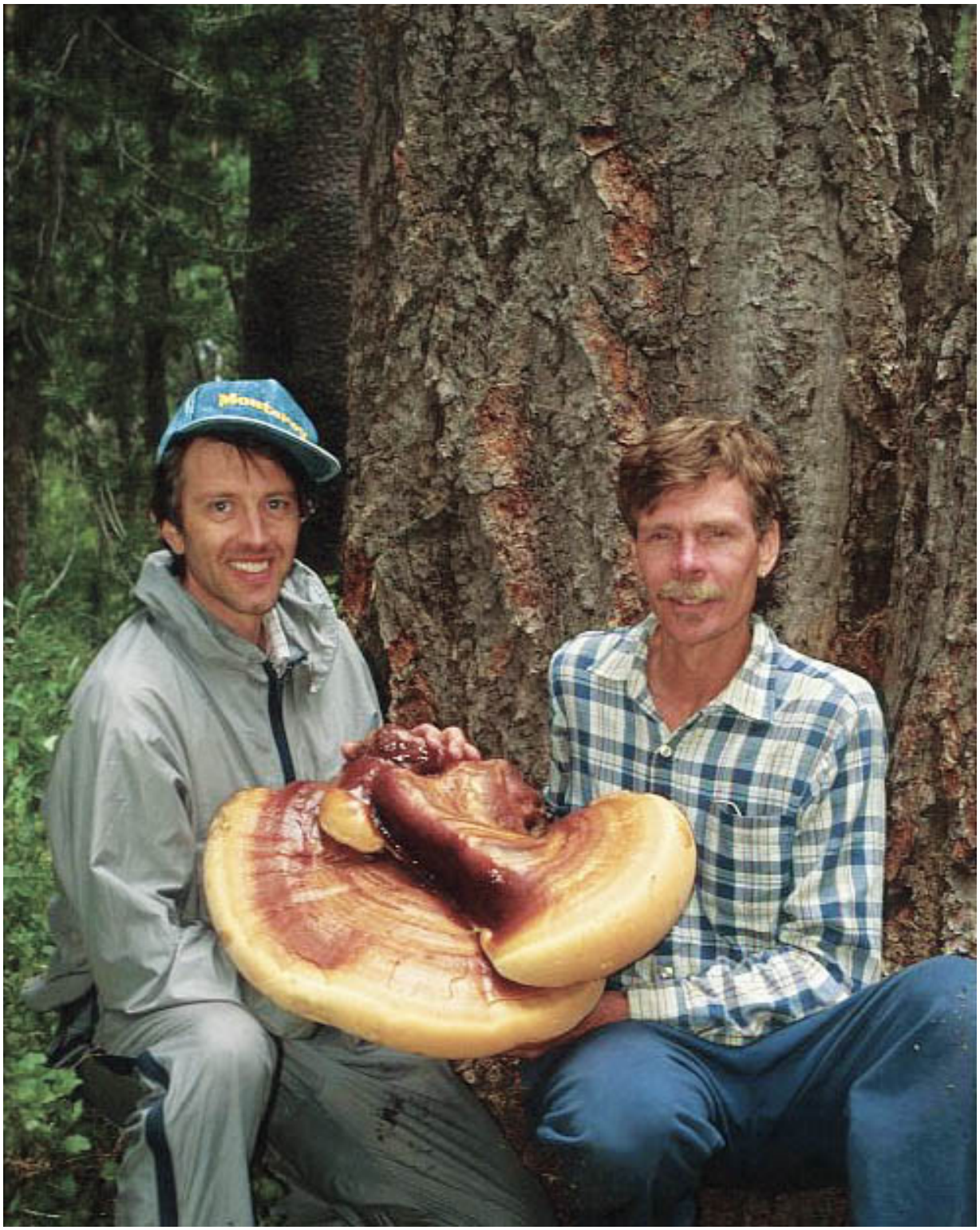
use either the dried tea or double-extraction for respiratory problems. The tea extract is best for cancer support programs.

In Chinese herb shops, reishi is sometimes sold in little vials of extract and honey. The extract is stabilized with vitamin C or alcohol (25 percent), and honey is added for flavor and sweetness.

Eat It Fresh

From my experience, some *Ganoderma* species can be eaten fresh, especially the margins of the cap, which can be tender, sweet, and slightly bitter — rather like the taste of fresh ginseng. This is particularly true for the very large and stalkless fresh fruiting body of *G. tsugae* that grows on recently dead hemlock trees in the western United States. In the eastern United States and in other countries, a stalked version of *G. tsugae* also grows on hemlocks and can be tender when young and fresh.

The Bencao Gangmu reports that tender reishi was eaten immediately, so no instructions for preparations were necessary. I've eaten it sliced thinly and added to soups or stir-fries. When eating fresh reishi, limit your consumption to no more than a tablespoon at a time, to avoid digestive upset (which I have experienced after eating about half a cupful). It's more the spirit of the mountains and the wild reishi we want to imbibe! It can also be simmered for 30 mintues, then blended with a little water (or perhaps ginger and licorice tea), stored in a jar in the refrigerator, and taken by the spoonful daily.



ABOVE: We found this 17-pound *Ganoderma tsugae* on a hemlock in the High Sierra. It was the most beautiful mushroom I've ever seen.

How to Recognize the Real Reishi

In searching Chinese herb shops for reishi, I have found up to 10 different species that look distinctively different from one another. Because of all the species variation in the marketplace, and some uncertainty about which exact species has been studied during many years of scientific research and reported in published studies, I have started referring to the various species as reishi-like mushrooms. (Indeed, somehow the name *Ganoderma lucidum* became associated with all the Asian species sold in the marketplace and the species used in clinics from the time it was named by Petter Karsten in 1881 until modern DNA testing became more widespread.)

Until there is further study, we can't definitively say that a particular species is more effective than another for treating particular diseases or symptoms. So which species is best to use, in general? And how do you recognize it?

I recommend using *G. lingzhi,* a very recognizable species of *Ganoderma*. This is the red reishi I have used to make tea concentrates for clinical and personal use for nearly 20 years. It is typically small to medium-sized and kidney-shaped, with a dusty, brick red cap that has alternating bands of light and dark. The stalk is short or nonexistant, showing that it was likely cultivated in poly bags of ground-up wood, or sometimes in other substrates. The

top of the cap is usually covered with a light coating of powder or spores that gives it a dusty appearance rather than shiny. I have performed DNA analysis on this species and have confimed it as *G. lingzhi.*

ABOVE: *Clockwise: G. sinense, G. sichuanense, G. sichuanense G. lingzhi, and G. lingzhi Cultivated Ganoderma species*

BLACK REISHI

Ganoderma sinense

Reishi Cultivation

You can produce fruiting bodies by growing reishi mycelium on sawdust or rice, or a mixture. Hardwood chips or sawdust are often more effective for producing fruiting bodies that are high in beta-glucans. You can even purchase a kit with a block of mycelium already grown out (see Resources). If the mycelium grows long enough and consumes as much of the substrate as possible, it will produce fruiting bodies with a high beta-glucan content. From research performed in my lab using the standard Megazyme kit, I measured 25 to 50 percent beta-glucans — the lower amounts were from reishi grown on cooked brown rice and the higher from those grown on wood.

ABOVE: Reishi from a Chinese herb shop

ID TRAITS OF NORTH AMERICAN *GANODERMA* SPECIES

SPECIES	TYPICAL APPEARANCE	NOTES
G. curtisii	Typically stalked with a rounded base like a scroll. Often with yellow highlights and red stalk.	Reported from the southeastern United States on hardwoods like maple.
G. oregonense	Fat, reddish brown to reddish purple fruiting bodies with little stalk or sometimes short to medium stalk; grows on hardwoods.	Common from British Columbia down to northern California on oaks and other hardwoods.
G. tsugae	Some are pure red, others have a yellow band around the margin. West	Typically found on dead hemlock trees. Widespread across North

	Coast specimens are often large, fleshy, not stalked, and grow at high elevations (above 6,500 feet). On the East Coast, they're more delicate and stalked, with yellow highlights.	America, though East and West Coast specimens may actually be different species. The margin is tender and edible after cooking.
G. sessile	Flat and round, rose-red to purple-red, sometimes dull.	Grows on the ground on tree roots, even in the grass, especially in the southeastern United States. I once found a large fruiting body on the roots of a dead maple tree in Atlanta (see the photo here).

Note: Ten species of reishi-like mushrooms have been found in the southeastern United States — most commonly *G. curtisii*, *G. sessile*, and *G. zonatum* (Loyd et al., 2018).

Related Species: Artist's Conk

Artist's conk (*Ganoderma applanatum* or *G. brownii*) is a related fungus that doesn't look or grow like a reishi-like mushroom but can still be used medicinally. In Chinese medicine, it is used to treat tuberculosis, cancers, cirrhosis, and chronic active hepatitis.

Unlike reishi, which produces a fruiting body that degrades within one year, artist's conk is a very hard mushroom that puts on layer after layer of tubes each year to produce spores; you can actually count the layers and determine how old the mushroom fruiting body is. Despite its density, you can still harvest it, cut it up (with heavy-duty gardening shears or a saw), boil it, and use it as an immunomodulating tea. When I lived in Santa Cruz, I used it to prevent colds and flu. I harvested it from bay trees or oak trees and made a strong, bitter tea, which I kept on the stove and drank several times daily during the cold and flu season.

G. applanatum grows worldwide, but it occurs in different forms. Some are smaller and have a white to brownish white cap. Others are large, heavy, dense, and completely brown with a snow white pore surface underneath that can be marked with a stick or stylus to create a lasting picture. Related species, such as *G. brownii*, which is

found on bay trees and other hardwoods in California, can be used like *G. applanatum.*

Collect fruiting bodies before they are attacked by insects or molds; look closely to make sure they are firm and not discolored. In very wet weather, they will eventually degrade. The pore surface should be snow white, and you should be able to mark on it. If the pore surface is dark, don't use it because it is likely to be old and the quality degraded. Slice them when fresh, as they can be like wood after they dry.

ARTIST'S CONK

Ganoderma applanatum

SHIITAKE

Lentinula edodes

The current Latin name was first published by David Pegler in 1976.

OTHER NAMES: *xiang gu* (Chinese, meaning "fragrant mushroom")

Shiitake is the second most widely cultivated mushroom in the world, behind the button mushroom. Although it's primarily thought of as an edible mushroom, it has also been widely studied for its healthful properties, which include immunomodulation; cancer prevention and treatment; liver health; boosting immune response to infectious agents like cold and flu viruses, and for HIV and hepatitis; and cholesterol management.[74] Eating two or three fruiting bodies several times a week will give your immune system a boost. And it certainly is delicious, just about any way you want to cook it!

OVERVIEW OF POTENTIAL BENEFITS

Support during cancer treatment programs, to ease side effects of chemo and possibly extend survival period with conventional treatments, according to clinical trials
Prevention of viral and bacterial infections; immune support for treating infections
Cardiovascular support and cholesterol reduction
Prediabetes support; blood sugar reduction
Liver health support

ABOVE: *Lentinula edodes*

Summary of Research Findings

Chemists and pharmacologists have extracted the mycelium and fruiting bodies of shiitake in many ways, trying to determine the nature of its most potent immunomodulating compounds. Many studies, as detailed below, show that different extracts and fractions of the cell wall are immunologically active. Any way you slice it, it's good medicine.

What Makes It Medicinal

LENTINAN. A highly purified beta-glucan fraction that was first isolated in 1969, lentinan has been used in a number of clinical trials that include people with gastrointestinal cancers as well as a few with other cancers. The beta-glucan fraction is similar in structure to the one found in reishi, turkey tails, and other fungi. Both lentinan and beta-glucans in general are the most widely researched immunomodulating components of medicinal mushrooms.[75] Many studies used injections of lentinan, with only a few studies using oral dosing.

LEM. *Lentinus edodes* mycelium (LEM) is a preparation of shiitake sold as a health food supplement throughout Japan. It's essentially a shorthand for various crude (unrefined) extracts from the cultivated mycelium, containing cell wall components like beta-glucans but also B-complex vitamins, glycoproteins, and various sugars, as well as ergosterol, a sterol vitamin D precursor. LEM has been used in animal studies and

a few human studies that show similar effects to lentinan, but more of the LEM studies include oral-dose shiitake beta-glucans.

FIBER. Shiitake contains about 25 to 35 percent soluble and insoluble dietary fiber (which includes 20 to 25 percent beta--glucans).[76] This fiber can help maintain healthy cholesterol levels, protecting the vessels, and can act as a prebiotic to encourage healthy gut microflora.

ERITADENINE. A special purine compound found exclusively in shiitake, this has been shown to have a cholesterol-lowering effect.[77]

Cancer Support

Clinical trials have been performed with shiitake mycelium extract with purified fungal beta-glucans (lentinan). All the clinical trials with lentinan have been conducted with cancer patients (gastric and other cancers), who have been given the extract by injection, along with standard-of-care chemotherapy, and more recently with immunotherapy.[78] Lentinan added to immunotherapy and chemotherapy conferred synergistic effects that showed better immune responses.[79] The best results in these clinical trials reported that for 78 patients with unoperable or recurrent gastric cancer, the overall one-, two-, and five-year survival rates in the patients receiving shiitake mycelium extract were 32, 13, and 10 percent higher, respectively, compared with those

receiving chemotherapy alone.[80] Although lentinan is often given by injection, 94 percent tumor inhibition has been reported when it is administered orally in animals.[81]

Liver Protection

Animal studies show oral doses of LEM have a protective effect on the liver. Some patients with chronic hepatitis B seroconverted (which means the virus could not be detected after treatment), and liver enzymes indicated liver inflammation went down.[82]

Bacterial Infections

A small study showed that lentinan had a protective effect against tuberculosis in humans. Shedding of the bacteria stopped after it had been seen in three patients for 10 years.[83] A similar effect was noted in animal studies.

Antiviral Effects

Lentinan had suppressive effects in animals against several types of viruses.[84] Another fraction of LEM, named JLS-18 (containing lignin, beta-glucans, proteins), was effective for blocking the release of infectious herpes viruses in animals.[85] Clinical trials are lacking.

Cholesterol-Lowering Effects

In several studies conducted by one research group, 30 healthy young women consuming 9 grams/day of dried or 90 grams/day of fresh shiitake mushrooms for seven days, experienced a 7 to 12 percent decrease in total cholesterol and a 6 to 7 percent decrease in triglycerides (dried mushrooms produced the greater effect). [86]

Besides having soluble and insoluble fiber, which can help reduce cholesterol levels in the body, shiitake contains a unique purine alkaloid called eritadenine — a potent cholesterol-lowering compound that works differently than statins. It increases HDL and reduces LDL cholesterol (the so-called "bad" cholesterol). The fruiting bodies of shiitake contain up to 6.3 mg/gram of eritadenine by dry weight. Since the compound is alcohol soluble, the double-extraction or a simple tincture with 80 percent ethanol/20 percent water will extract the highest amount. [87]

DRIED SHIITAKES

Blood Glucose and Insulin Regulation

In animal studies, shiitake had blood-glucose-lowering effects when used regularly because of its high fiber content and due to the action of a cell wall glycoprotein. Shiitake supplementation lowered plasma glucose by up to 21 percent and inceased plasma insulin up to 22 percent, compared to animals receiving a placebo.[88] Shiitake mycelium grown in nutrient broth had the strongest blood-sugar-lowering effect among five different mushrooms, including wood ear, cordyceps, and phellinus.[89]

Traditional Uses

Shiitake comes from the Japanese words *shii* (referring to the chestnut tree, on which it is often cultivated) and *take*, meaning mushroom. Shiitake has been renowned in both Japan and China as a food and medicine for thousands of years. According to historical records, in the second century CE the Japanese emperor Chūai was gifted shiitake by the Kyusuyu, a native tribe of Japan. Older documents record the use of shiitake in ancient China under the names *ko-ko* or *hoang-mo*.

Dosage

Use four to five medium-size fresh fruiting bodies in cooked dishes. For cooked, dried, and powdered fruiting bodies for teas or additions to soups, use 6 to 15 grams. Of the tea powder

concentrate, add 2 to 6 grams to smoothies or ginger tea or another herb tea, or put the tea concentrate in capsules.

What to Look for in Commercial Products

Making your own tea powder or liquid slurries from shiitake fruiting bodies is the most cost-effective and potent way to use shiitake, if you have the time to make them. Encapsulated shiitake mycelium products may be weaker than simply eating two or three cooked mushrooms several times a week.

If you are buying a commercial product, however, you may want to choose the form of shiitake you buy according to the condition you'll be treating. Most of the human studies have used a semipurified crude extract like LEM or a fully purified product like lentinan. This might be better for stimulating the immune system strongly to target tumor cells or a virus infection.

For long-term health purposes, prevention, or using a mushroom or mycelium supplement in a total program for health, herbalists often prefer a whole mushroom preparation where the fruiting body or mycelium is cooked to break the chitin/beta-glucan bond and break down the cell walls for better digestion and absorption of the nutrients and medicinal components. Which approach is better for prevention and support of cancer treatment programs, for blood sugar regulation, or for its overall immune benefit and antiviral effects? As an herbalist, I typically prefer a total extract, unless I see clinical trials that show the purified forms provide significantly more clinical benefit.

Harvesting, Processing, and Using

Shiitake has a long history of cultivation, going back at least a thousand years. [90] In fact, it has been so artificially selected for size and taste of the fruiting body that it was long assumed to not grow in the wild; there have been recent reports that it may have naturalized in the southeastern United States, however. Shiitake is not difficult to cultivate on logs or in sawdust (see the step by step). To make cultivation easier, though, purchase logs and blocks that are already grown out with mycelium. Put them in a spot that is out of the sun and keep them moist. They should begin fruiting within 10 to 14 days, sometimes longer. An inoculated log will fruit for up to seven years if the conditions are right and it receives regular moisture.

After harvesting, I cook the shiitakes well, blend them with the cooking water, add 1 teaspoon per pint of vitamin C powder, and store the mixture in the refrigerator up to a few weeks. If and when it develops any odors typical of fermentation, I pour out the unused portion and make a new batch. I recommend taking 1 teaspoon at a time one or two times daily for a general health benefit, and 2 teaspoons two or three times a day for specific health needs, such as when it's part of a cancer support program. I also make dried tea powder concentrates for longer-term storage, as with all the other species.

ABOVE: Shiitake grows readily and abundantly on hardwood, when conditions are right; one log can fruit for up to 7 years.

It's important to note that consuming raw or undercooked shiitake mushrooms has been associated with a painful skin condition called shiitake flagellate dermatitis.[92] So always cook your shiitakes thoroughly!

Shiitake has been renowned in both Japan and China as a food and medicine for thousands of years.

SPLIT GILL

Schizophyllum commune

The current name was first published by Elias Magnus Fries in 1815.

OTHER NAMES: *Jamur grigit* (Indonesian), *bai shen jun* (Chinese)

Split gill is a traditional food in many parts of Asia, where it is cultivated widely and sold in open-air markets. It has a high mineral and protein content, as well as delicious flavor and texture. Studies have shown it to have immunomodulating and anticancer effects. The genus name *Schizophyllum* means “split gill” because the spore-producing ridges underneath the cap are often divided or split, especially after they mature. The species name *commune* refers to the mushroom’s habit of growing in colonies of overlapping small, hairy caps with short stems.

OVERVIEW OF POTENTIAL BENEFITS

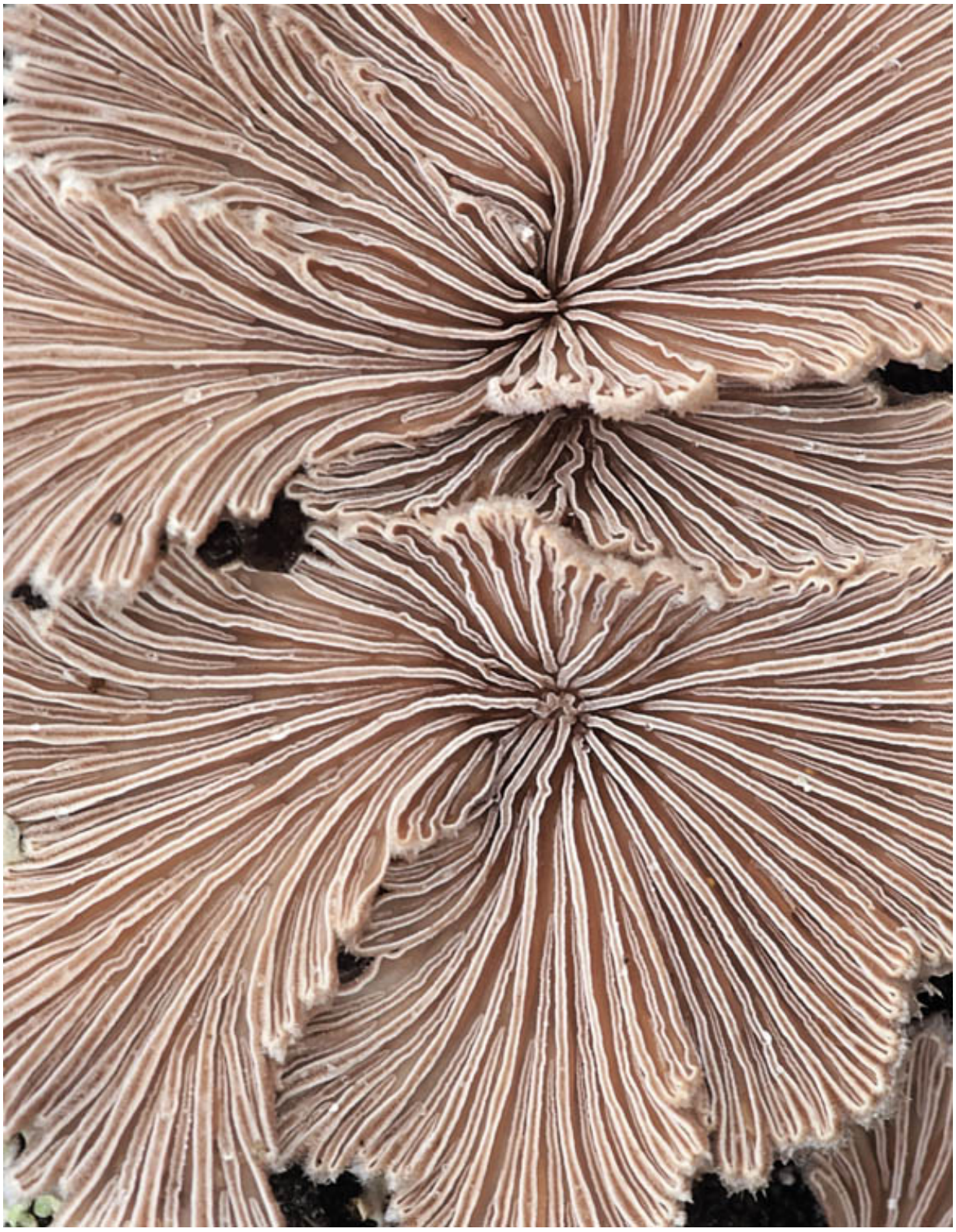
Antitumor effects

Antimicrobial effects

Antiviral effects

Immunomodulating

Increased survival rate among cancer patients



Schizophyllum commune

Summary of Research Findings

According to clinical trials, injections of split gill extract can significantly enhance the killing effects of radiation or chemotherapy in various types of cancers, including cervical cancer, leading to a higher rate of complete disappearance of the cancer. Animal studies show that oral doses of split gill beta-glucans are also effective as an immunomodulator and antiviral remedy.

What Makes It Medicinal

The fungal beta-glucan schizophyllan (also known as sizofiran) was isolated in 1970,[93] and more than 150 research papers show it has antitumor, anticancer, and antimicrobial effects. It has been studied in clinical trials and has been found to increase the long-term survival rate of cancer patients. As with lentinan (a beta-glucans fraction from shiitake — see the profile), nearly all of the studies in humans involved injections of schizophyllan; no clinical trials can be found with oral administration. However, animal studies clearly show that oral doses are immunologically active against cancer and viral infections.[94]

Cancer Support

Many laboratory studies have shown that the fungal beta-glucan isolate schizophyllan increases natural killer cell

activity, an important immune effect that not only increases the body's resistance against bacterial infection but also enhances the immune system's ability to kill tumor cells. According to human studies, schizophyllum extract or steamed powder can also help counteract neutropenia (reduced white blood cell counts) and immune suppression, which commonly occur during chemotherapy. The studies were performed on more than 367, 000 patients with gastric cancers. Better five-year survival rates and fewer side effects were noted in patient volunteers who received the mushroom preparation along with chemotherapy, compared with those who only received chemotherapy. [95]

The most recent clinical trial was a collaboration with 52 medical institutes in Japan, and the results were quite promising. Two hundred and ninety-two patients with stage II and III cervical cancer undergoing radiation treatment participated in the study. Schizophyllan was given in the dose of 40 mg once at the beginning, and 20 mg twice a week along with radiotherapy after that. The "complete response" (CR, or complete disappearance of all signs of cancer) in the radiation-only group with stage II cancer was 79.1%, compared with 91% in the group receiving radiation plus SPG (another name for schizophyllan). Among patients with stage III cancer, the CR rate was 61.2% in the radiation-only group versus 77.9% among those who also received SPG. [96] In this case, SPG was administered by intramuscular injection. Oral doses in the range of 6 grams/day of powdered tea extract could be considered for use.

Traditional Uses

Split gill is a nutritious food, widely added to dishes throughout Indonesia and other parts of Asia, as well as in Mexico. It is sometimes prescribed in traditional Chinese medicine for physical weakness and debility, also for gynecological disorders, and is recommended for seizure disorders.

Dosage

The dose is 6 to 9 grams of the dried fruiting body in teas, or 1 to 3 grams of the dried tea powder, twice daily. Occasional use in cooking can provide some moderate immune benefits.

What to Look for in Commercial Products

Commercial products in capsules, tablets, and tinctures are hard to find. It might be included in medicinal mushroom products that contain many different species as a general immune tonic. Split gill is a common wild species and also found in grocery stores or online where specialty Asian foods are sold, especially Indonesian markets. If you want to try split gill extract for a cancer support program, you will have to make your own, using the method on step by step.

Identification in the Wild

The split gill fungus often appears in field guides under the polypores heading, but although they are related, split gills are not actually part of that group. *Schizophyllum commune* is a unique species from an old lineage within the basidiomycetes group — fungi that produce spores on club-shaped organs — and is most closely related to the beefsteak fungus (*Fistulina* species). (By contrast, fungi such as morels and truffles belong to the ascomycetes group, which produces spores in sacs.)

Schizophyllum commune

Crepidotus versutus

The fruiting bodies of this species can be found on dead or dying trees, dead twigs, and composting grass on every continent except Antarctica. In addition to foraging for split gill, you could buy spawn and grow it on straw or wood. See the cultivation section, Growing Mushrooms at Home, for instructions. Split gill grown on grass or hay is more often used for food in Indonesia and parts of Asia.[97] Increased exposure to light triggers fruiting.

HABITAT. Split gill grows on a wide variety of dead or dying hardwoods and, to a lesser degree, conifers. I have seen it

mostly on oak, maple, and elms in the United States. When I lived in Santa Cruz and Davis, California, I saw large fruitings of them on dead oaks every winter.

ID TRAITS. Split gill is a very small fungus that often grows in overlapping groups of shaggy caps that have what look like brownish gills rather than pores. The gills are considered "cleft-gills," which is rare in macrofungi. Although quite variable in morphology around the world, some researchers consider them all part of one species.[98] They look like tiny oyster mushrooms that are shaggy on top.

LOOK-ALIKES. Few fungi look like split gill mushrooms. Small overlapping white caps of *Crepidotus* species can look similar, but on close inspection, the unique gills on the bottom of the caps frequently divide into two as they dry. The caps of split gills are tougher than those of *Crepidotus* species, which are tender enough to turn into a paste between your fingers with little pressure.

Harvesting, Processing, and Using

Split gill can be used fresh or dried for later use. After drying and storing, simply rehydrate them overnight in the refrigerator, discard the debris, and drain the mushrooms. The soaking water can be used to add extra flavor and nutrition. You can also make a dry tea extract of the fruiting bodies (see the step by step).

ABOVE: *Schizophyllum commune*

Cooking as a Meat Substitute

Western cultures consider split gill inedible due to differing standards of taste rather than known toxicity. In fact, it's a nutritious traditional food ingredient that can support immune function when eaten regularly. It's common in Indonesian cooking, and is eaten throughout India and southeast Asia. It's often pounded to tenderize it and turn it into a paste; mixed with fish sauce, garlic, and other spices; then cooked with vegetables and fish. After cooking, the mushroom has a chewy texture that simulates meat. The fruiting bodies contain about 23 percent protein. [99]

ABOVE: Split gill is commonly used as a meat substitute in Indonesian cooking.

A NOTE ABOUT SAFETY

Split gill fruiting bodies are not toxic. However, in very rare cases, when immunocompromised people are exposed to the spores, the fungus has actually grown in the body. Respiratory tract, including sinus, infections are reported in the literature, but these types of infections are incredibly rare, especially considering split gill's widespread use as a food. Topical and internal antifungals, such as amphotericin B, are used to treat such infections. [100]

A Salve for Treating Infections

You can use split gill to make a potent salve for treating infections. Blend, then soak the dried and powdered mycelium or fruiting bodies in strong alcohol (150 to 190 proof). After tincturing, mix it 50:50 with olive or almond oil (i.e., 4 ounces tincture to 4 ounces oil), then simmer the alcohol off on an electric burner (to avoid having the alcohol vapor combust; or just be careful on a gas burner). Add beeswax (about 1 ounce wax to 1 cup oil) and coconut butter (optional, 1 tablespoon per 1 cup oil), and let it cool into a salve. Apply to treat dermatitis and help heal wounds. Other mushroom species to use with this method include lion's mane, red russula, chanterelle, chaga, and mushroom caps from the genus *Leucopaxillus* (either *L. amarus* "bitter pax" or *L. albissimus* "large white pax").

TURKEY TAIL

Trametes versicolor

The current Latin name was first published by Curtis Gates Lloyd in 1921. (Formerly known as *Coriolus versicolor*)

OTHER NAMES: *Kawaratake* (Japanese, meaning “mushroom by the river bank”), *yun zhi* (Chinese, meaning “cloud fungus”)

These delightful denizens of the woods have many attributes. Among fungi, they are the most important and well-documented immune activator and cancer aid. Extensive research shows that turkey tail may help prevent cancer and support patients as they recover from cancer, as well as combat viral infections and address a host of other ailments. They have one of the highest percentages of beta-glucans — more than 50 percent.

OVERVIEW OF POTENTIAL BENEFITS

Preventing and treating infections and inflammation of the upper respiratory, urinary, and digestive tracts

Immunomodulating

Antiviral for hepatitis

Immune support during chemotherapy and radiation; alleviating side effects

Cancer prevention

Cholesterol regulating

ABOVE: *Trametes versicolor*

Summary of Research Findings

Of all the mushrooms used today for their medicinal qualities, more research has been performed on this species than on any other fungus, or rather the crude extracts high in beta-glucans, PSK, and PSP.

What Makes It Medicinal

BETA-GLUCANS. The particular beta-glucans found in turkey tail have been studied in human clinical trials for their demonstrated ability to activate our immune response against cancer, viruses, and other pathogens. Although we know a lot about turkey tail and its active beta-glucans, further research is ongoing to better clarify the preferred way to grow the mycelium or fruiting bodies to optimize their potent beta-glucans, terpenes, and other active compounds, and how best to process them and make the most effective extracts for the manufacture of dietary supplements. These studies will bring additional clarity about how to use them to their best advantage for prevention and to promote wellness for maximum immune and anticancer effects.

PSK EXTRACT. The most highly researched turkey tail concentrate is polysaccharide-K (PSK; brand name Krestin). Numerous lab tests and animal studies show PSK can enhance immune functions in profound ways. PSK also has antiviral and cholesterol-regulating effects, among other beneficial biological activities. PSK is reported to contain 62 percent

polysaccharides (non-starch alpha-, and beta-glucans) and 38 percent protein. [101]

PSK — or polysaccharide peptide (PSP), its Chinese counterpart — was used in nearly all of the clinical trials using turkey tail. PSK was developed in Japan and PSP in China from different strains of *T. versicolor*. These expensive commercial products from Asia apparently have only recently become available in the United States. It's not clear if what is being offered is made exactly like the original products used in clinical studies, but likely they are not. Companies selling PSP or PSK turkey tail products must have documentation that the strain used is COV-1 or polysaccharide-K, and that the mycelium was grown in liquid culture and not on other solid media (which could contain significant levels of starch).

PSK was first approved by the Japanese ministry for the treatment of cancer in 1977, and by 1987 accounted for 25.2 percent of the total national expenditure for anticancer agents. PSK is given orally (often 3 to 6 grams/day), along with several different chemotherapy protocols.

Some of the clinical trials performed with PSK demonstrate improved quality of life after surgery in patients taking turkey tail with chemotherapy. In some studies, it's associated with extended 5- and 10-year survival rates, especially for colorectal and stomach cancers. Turkey tail extract appears to decrease nausea, improve immune functions, and boost energy levels — counteracting some of the major side effects of chemotherapy. [101]

Cancer Treatment and Prevention

Turkey tail is the most widely studied of all medicinal species for its immune-stimulating and anticancer effects, with more than 40 clinical trials comprising over 18,000 patient volunteers with stomach, colorectal, esophageal, and breast cancers. The best of the results show increased five-year survival rates for patients taking a concentrated mycelium crude extract of turkey tail over those taking chemotherapy alone.[103] Further results show anticancer benefits, including improved immune status in the patients who take turkey tail compared to those with chemotherapy alone. At the same time, the patients in clinical trials taking turkey tail with chemo have reported better quality of life, even in advanced cancers, and reduced symptoms of fatigue, nausea, and decreased appetite.[104]

Clinical research shows that the use of turkey tail extracts during conventional cancer treatments may also reduce the possibility of secondary cancerous cells developing from the body's healthy cells after being damaged by radiotherapy and chemotherapy. Additionally, turkey tail extracts can protect the body's healthy cells from the toxic effects of chemotherapy and radiation therapy, caused by free radicals — those highly charged oxygen atoms that bind to DNA, proteins, and fats in our cells and cripple or destroy them.[105] The immunoprotective effects of turkey tail extracts may be particularly useful for cancer patients who are already immunocompromised, such as the elderly or patients with HIV or other infections. In patients with colorectal and gastric cancers who took 3 grams daily of PSK, short-term effects were

seen for stimulating the protective activity of peripheral blood lymphocytes, but further beneficial effects were noted after taking PSK for more than 14 days. Taking PSK every other day had the same benefits. [106]

Turkey tail extracts, preferably standardized to at least 10 to 20 percent beta-glucans, can help activate our immune response in a way that may help prevent cancer. When used on a regular basis as a supplement to a healthy diet, turkey tail extracts can potentially inhibit cancer cell growth by reducing the effects of some carcinogens, such as those in tobacco smoke or asbestos, on susceptible body cells.

PSK OR HOMEMADE PREPARATIONS?

The company that produced PSK utilized a specific method to increase the level of beta-glucans in their product. They used only mycelium that was cultivated in large fermenters, and the fungi were provided nutrients in a broth so they would grow well and produce a high content of beta-glucans. After the mycelium was completely grown out in the broth, the liquid was removed, leaving pure mycelium. The mycelium was then ground up and extracted by boiling with a base, such as sodium hydroxide, to pull out some of the pure beta-glucans. This process was repeated several times until much of the beta-glucans and proteins were extracted. The “spent” mycelium was then removed (which would have also removed any remaining active compounds in it, such as more beta-glucans, chitin, and

proteins, as well as low-molecular-weight molecules like phenolics and triterpenes).

It's helpful to know how these products are made, but is it necessary to go through this process in order to create potent medicine? Fortunately not. Making turkey tail extracts at home can still provide high levels of beta-glucans and provide excellent results. Cooking them in a pressure cooker or by a long simmering can still make a significant amount of beta-glucans available to activate our immune system as they travel down the digestive tract. And when the whole mushroom is pressure-cooked, blended up, and dried, you also get the essential soluble and insoluble fiber for cardiovascular protection, along with vitamins, minerals, and triterpenes, which likely have an anti-inflammatory effect. [102]

Immune Boosting

Studies show the well-researched commercial products PSK and PSP have a broad spectrum of multifunctional immunological effects, some of which might be triggered through contact with immune tissue in the digestive tract. [107] In these products, mushroom cell wall components like beta-glucans and chitin, as well as others, have complex interactions with our body's immune sensors, such as toll-like receptors, in the small intestine as the turkey tail cell walls are processed and pass through our body. After fungal beta-

glucans are recognized by our body, a complex immune response takes place that leads to cancer and tumor cell suppression and greater surveillance and antibody production to identify and target potentially pathogenic viruses and bacteria. [108]

Cholesterol Regulating

The cardiovascular benefits of turkey tail are a result of its high fiber content. Sterols such as ergosterol are also abundant in the cell membranes of fungi. Sterols are chemical compounds that have 30 carbon atoms along with hydrogen and oxygen and are common components of cell membranes in animals that help make them flexible. They work by reducing the buildup of cholesterol in the blood. Whole turkey tail powder or the tea extract lowered serum cholesterol, including LDL and increased HDL, in a small human study and in animal studies. [109] Other preliminary research showed turkey tail has a mild blood-glucose-regulating effect and reduces insulin resistance in laboratory tests. [110]

Traditional Uses

In traditional Chinese medicine, turkey tail is used to clear dampness, reduce phlegm, heal pulmonary disorders, strengthen the physique, increase energy, and support patients with chronic diseases. [111] In Mexican folk medicine, the fungus is used to cure ringworm and impetigo.

Dosage

Application and dose is individual, but for a beginning or maintenance dose, use 1 to 3 grams/day of powdered tea extract in a smoothie or other drink, or two “00” capsules twice daily, depending the amount of actual turkey tail prepared material is in each cap. Each “00” cap contains 400 to 500 mg of material, and each smaller “0” cap contains 300 mg. If a higher dose is desired, up to twice that amount (four capsules twice daily) is often recommended. Use about 27 grams/day of the dried and finely powdered mushroom fruiting bodies soaked for 20 minutes in freshly boiled water (or hot ginger tea) for acute conditions like an upper respiratory tract infection, and 10 to 15 grams/day during winter as a preventive against viral infections. [112]

Mushroom fruiting bodies should be thoroughly simmered for at least one to two hours (or 30 minutes in a multicooker set to high), then blended up with the cooking water. Refer the step by step for more information on making powdered tea extracts.

Identification in the Wild

Trametes versicolor is an excellent fungus to collect in the wild, as it is widespread, abundant, and has no toxic look-alikes, once you become familiar with it.

ABOVE: Left to right: Two true turkey tails and one gilled turkey tail.

HABITAT. Turkey tail is a nearly ubiquitous polypore fungus, growing in forests on nearly every continent. It grows on dead and decaying logs of almost any kind of tree but prefers hardwoods such as oaks, especially those in wet areas like creek beds. It can also grow on fruit tree stumps or logs; I have seen them on conifers only rarely.

ID TRAITS. Turkey tail is striking when you come across it in the woods. True to its name, its multicolored (hence the species epithet, *versicolor*) fruiting bodies do resemble the bands of a turkey's tail, and they often stand out in fall and winter when no other flowers or mushrooms are about.

The fruiting bodies are thin (the genus name *Trametes* means "one who is thin"), flexible when fresh, and rigid when dry, and they grow in overlapping clusters. The top is zoned, usually in shades of brown, white, gray, or blue (and this is highly variable), with alternating hairy bands. The underside of the cap is snow white — especially if it has recently emerged from a log and has not started to degrade — and shows minute pores that do not discolor after scratching. You can feel the texture of the pores if you run your fingertip or fingernail over it. Smell is an important way to confirm the identity of many mushrooms; fresh turkey tail smells pleasantly like cream of mushroom soup.

ABOVE: As its species name, *versicolor*, suggests, turkey tails can be found in many different color combinations.

LOOK-ALIKES. Turkey tail has no toxic look-alikes. The most similar fungi that grows widely in the same habitat, sometimes on the same log, as turkey tails is the ubiquitous "false turkey tail" from the genus *Stereum*. *Stereum hirsutum* is one of the most common polypores I've come across in my many jaunts in the woods. It grows abundantly on dead logs everywhere,

sometimes in mass fruitings right next to turkey tail fruitings. Fortunately, it is easy to discern by turning the individual fruiting body over and noting that it is buffy orange to tan and is completely smooth, unlike the turkey tail fungus which is white and rough with tiny but perceptible pores. False turkey tail is completely safe to cook up and try, but it does not have the same research and history of use that turkey tail does. Gilled turkey tail, *Trametes betulina*, has gills on the bottom and can also be used.

Turkey tail is an important part of the forest ecology because its primary job is to recycle dead branches and whole trees and release the carbon in the form of energy and structural building blocks for other organisms in the forest to use, thus perpetuating the cycle of life. It has an array of powerful enzymes that can break down cellulose and lignan, the main structural material of plants and trees.

Harvesting, Processing, and Using

You may occasionally find massive fruitings of turkey tail. When they are young and tender, not dried out, you can pull them off easily by holding on to the cap and pulling downward. Always leave at least a third of the fruiting bodies to disseminate spores.

You can chew the fresh mushroom raw (it tastes and feels something like mushroom-flavored chewing gum, which is actually more enjoyable than one might first imagine). I often chew on two or three of the fresh fruiting bodies as I'm walking in the woods. However, I do know some mushroomers

who have chewed them raw and thought they tasted pretty bad. Taste is in the mouth of the chewer, it seems!

Turkey tail can be consumed as a tea or in a soup stock. The tea is mucilaginous and has a flavor and fragrance that is reminiscent of cream of mushroom soup. The mild-tasting fruiting bodies, powder, or hot-water extract can be used to make an immune-boosting soup stock. For instructions on making powdered tea extract, turn to the step by step.

For longer-term storage, freeze the fruiting bodies promptly after harvesting (to prevent damage from larvae) for three days, then dry them in a food dehydrator at about 100°F/38°C. Alternatively, you can air-dry them by spreading them out on a screen in a warm place with a fan blowing across them.

Stereum hirsutum (a turkey tail look-alike)

What to Look for in Commercial Products

Look for products that contain both the fruiting bodies and the mycelium, preferably organic. Commercial products in capsules that are derived from mycelium grown on rice may contain fewer beta-glucans and should be tested with iodine to make sure they don't contain significant amounts of starch.

Concentrated powdered tea extracts are available in capsules or tablets. PSK or PSP extract is available in capsules or tablets but these are quite expensive because they are patented medicines in Japan and China. Tinctures are generally inferior for immunological, anticancer, and antiviral effects because the active beta-glucans are not alcohol soluble.

Although dried fruiting bodies are not typically available at regular retail outlets, boxes of them can be found in Chinese herb shops. Keep in mind, though, that these fruiting bodies may be of questionable quality. They may have been fumigated to help preserve them from insect damage (which doesn't always work!), and it's difficult to say where they were grown or how old they are by the time you purchase them.

Kits are available for growing your own fruiting bodies and mycelium. Still, harvesting from the wild is one of the best sources for quality fruiting bodies because they are so common in many habitats where dead or dying hardwoods are available.

野生選雲芝
CORIOLUS VERSICOLOR
淨重:300g

LESS-STUDIED SPECIES WORTH NOTING

FU LING

Wolfiporia extensa

WOLFIPORIA EXTENSA **IS ONE OF THE** most widely prescribed herbal remedies in traditional Chinese medicine. Known as *fu ling*, it has been extensively used in traditional herbal prescriptions for at least two thousand years and today is an ingredient in at least three hundred traditional prescriptions. Fu ling is often added to help strengthen the digestion, drain excess water or fluids that are not needed by the body, and restore proper immune function. Specific indications for fu ling include heart palpitations, headache, dizziness, and insomnia, depending on the "pattern" or present condition of the patient. [113]

The part of the fungi used for medicine is not the fruiting body but rather a hardened mycelial mass that is loaded with food reserves. This sclerotium, as it's called, forms a round ball underground that looks like a coconut (hence its original Latin name, *W. cocos*), with a dark exterior and white interior. The fungus grows in many parts of the world, including throughout the United States, Canada, Australia, and Asia.

Historically, the sclerotium is cut to produce a thin slice that curls up when dried, or in various-sized blocks. Each of the forms are thought to have a different therapeutic use. For instance, the curls are used to "calm the spirit," to ease nervous anxiety. The "skin" or outer covering of the sclerotium is also

used separately in traditional Chinese medicine to clear inflammation.

Dozens of research studies have explored the beta-glucans and triterpenes in fu ling. The beta-glucans specific to fu ling were isolated before 1980 and called beta-pachyman and pachymaran. Fu ling is rich in triterpenes that have sedative, diuretic, and anti-inflammatory effects that work on pathways implicated in arthritis and other chronic diseases. The usefulness of hot-water extracts in these conditions awaits more clinical trials, but the research so far is a promising start. These active beta-glucans and terpenes are known to have immunomodulating, anti-inflammatory, wound-healing, antiparasitic, anticancer, and diuretic effects, among other activity. In China, fungal-based skin creams (including those containing fu ling) have shown positive results for reducing inflammation of dermatitis, lightening skin with hyperpigmentation (such as freckles and aging spots), and helping heal wound infections. [114]

To ensure a steady supply for use in modern nutraceutical products and protect its population in the wild, fu ling is cultivated on cooked rice rather than wild harvested. As with other mushrooms, commercial products that include fu ling should be tested for starch and beta-glucans, as well as total terpenes.

The few small clinical trials so far have mostly focused on external use of fu ling. [115] Many animal studies have been published, and the human studies available focused on a well-known traditional formula, called Guizhi Fuling Formula, that contains cinnamon twig and other herbs along with fu ling. Conducting clinical trials on traditional formulas is common

practice in China, and understandable, since they are widely used and prescribed in hospitals and clinics. [116] However, with this approach it is impossible to determine the exact benefit and pharmacological action of fu ling on its own.

JELLY FUNGI

These genera of fungi produce jellylike or cartilaginous fruiting bodies. Some of them have been eaten as food (and medicinal foods) since ancient times.

Snow Fungus

Tremella fuciformis

Also known as white jelly mushroom, *bai mu er* (in Chinese), and *shiro kikurage* (in Japanese), this beautiful fungus is rarely seen in the wild in North America, but it is widely cultivated and readily available dry in Asian grocery stores or herb shops. It is one of the most popular fungi in Chinese cuisine. Bags and bags of them stuff the shelves, indicating their popularity. When cultivated, *T. fuciformis* is actually a parasitic yeast. Growing on its own, it looks like a slimy, mucuslike film. When it comes in contact with another genus of fungi, *Annulohypoxylon* (which looks like round, black carbon balls on dead oaks and other hardwoods), *T. fuciformis* parasitizes it, triggering the production of vigorous mycelium growth and white translucent fruiting bodies. [117]

The dried fungus is soaked to rehydrate, then added to soups and stir-fries. The fungus itself is bland and will take on

just about any flavor you add. The texture is cartilaginous but pleasant, adding an extra and often delightful difference to the overall gestalt of the soup or stir-fry. The great thing about using this fungus in cooking is that you are getting good medicine with your meal.

SNOW FUNGUS *Tremella fuciformis*

In traditional Chinese medicine, a few species from the genera *Tremella* and *Auricularia* are known as *mu er*, which means "wood ear" or "tree ear," and *bai mu er* is "white tree ear." These species are considered a Chinese treasure and are mentioned in the greatest of all Chinese herbal texts, the Bencao Gangmu (see The Bencao Gangmu: A Chinese Herbal Treasure) for their healing qualities. Traditional uses for bai

mu er include for yin deficiency, which is related to chronic inflammatory conditions in the body that underlie most chronic diseases. It has been widely used as a tea or medicinal food to benefit the lungs and counteract inflammatory conditions and infections of that organ. One might use it for chronic lung conditions such as COPD or asthma, more as a preventive and supplement to help the body in repair of the lung, reducing inflammation, and regulating immune responses. Traditionally, it is also used for reducing inflammation in the liver caused by infections or the excessive use of alcohol or drugs. More recently, bai mu er has been marketed in China as an antiaging supplement and has more than 40 Chinese patents.

As with other mushrooms, modern laboratory studies have shown it to have unique beta-glucans and other compounds with antitumor, immunomodulatory, antioxidation, antiaging, anti-inflammatory, hypoglycemic, and hypocholesterolemic effects when eaten regularly or as a dietary supplement. [118] New research has identified a neurological benefit — stimulation of new neurites or nerve cells in vitro and in vivo. [119] A recent randomized placebo-controlled clinical trial explored the cognitive effects of daily bai mu er supplementation. In the trial, 75 volunteers with cognitive impairment took 600 mg/day or 1,200 mg/day or a placebo. Both groups receiving *T. fuciformis* experienced significant improvements in short-term memory and executive functions compared with those receiving the placebo. Adverse events reported were lowest in the low-dose *T. fuciformis* group, but were minor. [120]

DRIED BAI MU ER

Tremella fuciformis

WITCH'S BUTTER
Tremella aurantia

Witch's Butter

Tremella aurantia, T. mesenterica, Dacrymyces chrysospermus

A very rainy day can bring out the bright orange witch's butter in full force. The small slimy masses show up literally

overnight, covering entire logs with orange jelly. The lumps feel slimy when handled and rather like gelatin. Nothing looks like them, so the identification should be straightforward once you see a picture and then see them live. The brown witch's butter (*Tremella foliacea*) is also quite widespread in the United States and can be used similarly.

In traditional medicine, they are prescribed for soothing stomach ailments. They can inhibit *Helicobacter pylori*, the bacterium most associated with gastritis and peptic ulcer, and while in one study this fungus did not eliminate *H. pylori*, it did ease the symptoms, suggesting that it could be used with other therapies.[121] Some studies demonstrate that an extract of witch's butter reduced blood sugar levels in human volunteers when used more than 15 days.[122] Beta-glucans are also present, though not in high amounts.

If I see fresh ones as I'm wandering around the woods, I'll pop them into my mouth and let them dissolve. They taste bland (perhaps with a faint apricot flavor in some populations) and feel gelatinous in the mouth, but I've developed a rather unusual fondness for them. They can be dried and rehydrated in soups, as is practiced in Asian cooking.

Wood Ear Fungus

Auricularia auricula-judae, A. heimuer

Cloud Ear Fungus

Auricularia nigricans (syn. A. polytricha)

These two related fungi from the genus *Auricularia* are used interchangeably in Chinese cuisine and medicine, where they are known as *hei mu er* and *mu er*. Members of the genus provide about 17 percent of the world mushroom production as a source of nutrition — protein, vitamins, and minerals plus traditional medicines.[1][2][3] They are widely used for food and medicine in Africa, Asia, Europe, New Zealand, and Mexico. Of the two species, *A. auricula-judae* is tougher than the more delicate cloud ear fungus (*A. nigricans*), which makes it better suited to soups than stir-fries. Both species truly do look like ears, complete with ridges. The texture is cartilaginous and chewy, in a pleasant way, and the flavor is mild.

WOOD EAR FUNGUS

Auricularia auricula-judae

During my time studying traditional Chinese medicine in China, I enjoyed wood ear so much that my teacher wrote out "Please add more mu er" in Chinese characters so I could show it to the waiter. Despite having a tutor to learn some Chinese words and phrases, the more I practiced, thinking I had it down perfectly, the more blank stares I got when trying to order different foods in restaurants. I never could get the tones right.

In traditional Chinese medicine both species are used as a medicinal food. They are renowned for improving blood circulation and "building the blood," which is a traditional

Chinese medical term for increasing the oxygen, carbon dioxide, immune cells, energy, and hormone-carrying capacity of the blood. It is thought to help regulate menstrual flow and to shrink hemorrhoids and relieve discomfort, among many other uses. For the elderly, it is recommended to help remove aging spots when eaten frequently and/or applied to the skin.[124] Recent research considers it beneficial to the cardiovascular system and for lowering cholesterol.[125]

A strong anticoagulant effect has also been noted by researchers. This may be beneficial for those who have beginning cardiovascular disease, rather like taking a baby aspirin to help prevent abnormal clotting. This may be contraindicated for those who are taking blood-thinning medications, so be sure to discuss the frequent use of either type of mu er with your physician.[126] In traditional Chinese medicine, eating or taking an extract of one of the wood ear mushrooms is sometimes recommended when the menstrual flow has stopped, but in some women it might have the effect of increasing the blood flow to an unwanted level. Increased bruising may also occur in rare cases.

Numerous health and medicinal uses are common for these two species in China and other parts of Asia.[127] The high fiber content can help ease gastric inflammation and ulcers and ease constipation when cooked and eaten in various dishes or as a tea powder. A plethora of research studies (mostly laboratory studies) detail its usefulness for cancer prevention and support, immunomodulation, antiviral and antibacterial effects (use a tincture), blood sugar regulation, cholesterol balance, as a prebiotic to encourage beneficial species, and as an antiaging and antioxidant supplement.[128] Finally, a meta-

analysis and systematic review showed that a beta-glucan extract from wood ear (*A. auricula-judae*) significantly increased the treatment response rate to chemotherapy for the six-month, one-year, and two-year survival rates for gastrointestinal cancers. The meta-analysis included 33 clinical trials (hepatocellular cancer, 22 studies; colorectal cancer, 5 studies; gastric cancer, 2 studies; esophageal cancer, 1 study; and mixed cancer, 1 study) with 2,884 patients, which clearly shows the research interest and therapeutic effectiveness and promise for future research. [129] A general trend in many of the studies was improved immune response for the participants who received wood ear rather than the placebo. The dose generally used was 20 grams three times per day of wood ear granules. Many of the studies were recent and of high quality.

PREPARING WOOD EARS

A traditional recipe calls for dried wood ears to be soaked overnight then cut into small squares and cooked with soybean paste, soy sauce, water, and cornstarch to make a thick sauce. Add garlic, onion, and ginger as well as sugar, if desired. Afterward, add meat and vegetables such as carrots. Traditionally the meat is pork (I would substitute strips of tofu). The entire meal was considered a good "yin tonic" that could reduce inflammation and strengthen and regulate the adrenal hormones, among other effects. Red Chinese dates (*Zizyphus jujube*) were often added, which

provide body and sweetness, as well as strengthening the digestion.

Both species are typically available dried or fresh in Chinese markets, specialty groceries, and online from commercial growers. The spawn is also readily available. In the wild, they can grow abundantly in wet climates. I have collected them in a London park and have seen them growing abundantly on dead logs in the Amazon. They grow in many parts of the United States, especially where summer rains are frequent. Recently, DNA analysis of the genus has shown that *A. auricula-judae* is really a complex of at least seven species, including *A. heimuer*, which is widely cultivated in Asia. The similar-looking *A. americana* is distributed in the Far East and in North America.[130] However, problems still exist with these names. All we know for sure is that the North American species of *Auricularia* are not *A. auricula-judae* but a closely related species that can be used similarly.

WOOD EAR

Auricularia polytricha

HONEY MUSHROOM

Armillaria mellea

IN TRADITIONAL CHINESE MEDICINE, honey mushrooms are considered effective for epilepsy, for nervous system complaints like sleep disorders, to regulate cholesterol, to treat upper leg pain (perhaps like sciatica), and to improve night vision (it is high in beta-carotene). The fungal extract is reported to increase blood flow to the brain, and to help reduce symptoms like dizziness, insomnia, and ringing in the ears (tinnitus). Honey mushrooms are high in fiber and have some of the highest levels of immune-stimulating beta-glucans; one recent study found 33 to 39 percent in the cap and stem.

ABOVE: *Armillaria mellea*

Another recent use of the honey mushroom is as a substitute for gastrodia or *tian ma* (*Gastrodia elata*) — a well-known, expensive Chinese traditional herb that is harvested in the wild from a tuberous orchid. The orchid was thought to be difficult (or impossible) to cultivate, until growers discovered that it needed the honey mushroom as an ectomycorrhizal partner to grow well. At some point, it was found that a significant part of the activity attributed to gastrodia was due to compounds the honey mushroom produced. Researchers of this most interesting synergistic fungus-orchid medicine claim that "*A. mellea* is an unparalleled source for the discovery of new bioactive natural products . . . in epileptic therapy" (for treating epilepsy). They concluded that the active compounds thought to be from gastrodia were mainly metabolites of the *Armillaria* mushroom. [131]

Tian ma is prescribed by practitioners of traditional Chinese medicine for childhood convulsions, epilepsy, spasms, contraction of the muscles (tetany), and the neurological effects of strokes attended with nerve damage. It is also widely used for headaches, dizziness, vertigo, migraine headaches, tingling, and numbness. [132] This major Chinese herb is irreplaceable in practice.

Very few clinical trials involving honey mushrooms are available on PubMed, but over 40 animal studies demonstrate a variety of biological effects. Recent studies showed honey mushroom could improve insulin resistance. Many studies show an antioxidant and anti-inflammatory effect, and two show benefits treating Alzheimer's disease. [133]

The honey mushroom grows in abundance in fall and early winter, although its appearance is quite variable. A number of distinct genetic races occur worldwide. Typically, they can be found in small to large clusters, sometimes with massive fruitings on deadwood, downed trees, or even on live trees; they are parasites known to attack live fruit trees, especially. The fruiting bodies have a felty ring on the upper stem. It's a little skirt that sometimes dissolves as they get older. The caps are tan, yellow to amber, honey-colored to brown with striations and fibrils (dark hairs) on the top, which is characteristic of the species. The spore print is white.

Honey mushrooms are best when picked young, with the margins of the cap still curved down and inward. The fruiting

bodies are still fine when they fully open, but they should be firm (not tough) and not discolored or wormy. After being sliced and cooked, they have an inviting texture and taste. Many are very mild tasting, though some fruiting bodies can be a little bitter, so taste a small piece first before harvesting a lot of them. To preserve the fruiting bodies, harvest them, clean them, freeze them overnight, then dry and store or make a tea extract.

The honey mushroom has a claim of being one of the world's oldest and largest organisms, the mycelium of one genetic clone covering many miles under the ground.

The dose of the dried fruiting body is up to 30 grams a day (15 grams twice daily). If you find some and simmer them down to make a tea concentrate powder, the dose is about 3 grams twice daily. Higher doses can be used for difficult problems, but ramp the dose up slowly over a week to check for sensitivity and gastric upset.

GASTRIC UPSET?

It has been reported that eating “honeys” can cause upset stomach in some people, especially if they are not well cooked. I have seldom noted adverse reactions from eating

them (in myself or those I've served them to). Years ago I cooked up a batch for a group of 20 students. We had them plain with just a little salt and a bit of garlic. Out of the 20, only 1 person reported mild stomach distress and nausea for an hour, then it seemed to subside. Other mushroomers report that gastric upset is more common with species found in western North America. Throughout the country, honey mushrooms have diverse and variable genetic makeups, and there are other species that appear similar to *A. mellea,* which may explain the increase in gastric upset. It's best to eat the young caps and discard the stems, and cook them thoroughly.

ABOVE: honey mushroom

RUSSULAS AND MILKY CAPS

Russula species and *Lactarius* species

THIS IS A LARGE GROUP OF COMMON, easily identifiable fungi with firm, brittle flesh and gills that often have a waxy feel. If you hold a fruiting body up to your ear and run your thumb down the gills, you should be able to hear the snap and crackle of the brittle gills breaking. I'm not aware of another group that does this. The stem should snap off clean, like a piece of chalk (compared to other mushrooms, which will shatter or splinter, or simply bend. Milky caps and russulas (pronounced *roos-you-lasz*) come in many colors — white, yellow, green, brown, purple, and red. Not surprisingly, the bright red species are typically not eaten, especially *Russula silvicola*. (See For the Love of Russulas for an exception.) They can be acrid and cause nausea and vomiting, even after being cooked.

ABOVE: Among members of the genera *Russula* and *Lactarius*, the stem snaps like chalk and the waxy, brittle gills make a crackling sound when broken.

The differences between the two genera in this family of fungi are easily seen. Cut across the gills with your thumbnail or a small blade, and if a clear or milky liquid slowly or fairly quickly oozes out, you have a milky cap. At times the liquid is almost nonexistent, but the damaged area will sometimes discolor. In some species, the milk can be yellow or orange, or slowly changes from white to yellow, or shows other color changes, which can be a sign not to eat them. The edible "delicious milky cap" (*Lactarius deliciosus* group, which some people actually do *not* find delicious) has milk that turns green after the mushroom is handled or even with age. The key is the taste. Taste the base and gills of russulas or milky caps carefully; if acrid at all (creating a burning sensation), spit it out and reject it for cooking purposes.

Many russulas and milky caps are eaten in eastern Europe, including Russia. In taste tests at David Arora's annual Thanksgiving mushroom retreat on the north coast of California, he has us tasting many different species and then voting on our favorites. Some russulas are consistently rated high or even at the top of them all.

ABOVE: *Lactarius deliciosus*

ABOVE: *Lactarius deliciosus* stains green when bruised.

Russula sanguinea

ABOVE: Milk from milky caps

ABOVE: *Lactarius fragilis*

Some species of *Russula* have been studied for their blood-glucose and serum-lipid-lowering effects, antioxidant and antimicrobial activity, and antiviral effects in laboratory tests. [134]

Species from the genus *Lactarius* (including *L. deliciosus*, a choice edible) have immune-regulating, antioxidant, and blood-sugar-lowering effects. [135] *Lactarius* species are known to contain antimicrobial sesquiterpenes. [136] These biological effects are the reason for their use in Siberia, as agents to help

fight infections, but other clinical uses will have to wait for human studies.

People in some regions of Russia and other eastern European countries have learned to eat many russulas and milky caps because in some years it may be a major food source, especially in rural areas. Milky caps are typically leached and fermented by salting to make "salted milky caps." This gets rid of the spicy compounds, so they can be eaten. This processing and use of mushrooms from this group is common in some traditional cultures. If the spicy toxins are not removed, they can be nauseating. Interestingly the spicy compounds (which are largely sesquiterpenes) have strong antibacterial, even antifungal properties — for instance against candida — and were formerly used in alcoholic extracts for treating wounds.

FOR THE LOVE OF RUSSULAS

A few years ago, I met two Russian mushroom lovers in our local mushroom club. We were on a foray, and I noted they were picking the yellow-staining milky cap, *Lactarius alnicola*. After tasting it, I had rejected it out of hand because it was so acrid — it put the hottest radish to shame! But they were filling up their entire baskets with them. One of them told me, "When we smell milky caps like these, we go crazy!" After letting this sink in, I asked how they could eat them and not get sick. She detailed the process of salting and fermenting the mushrooms, and said

they were then used as a side dish or relish in many parts of Russia. The next time we met, she was kind enough to show me the process and let me taste the finished product. The basic recipe begins by sterilizing a glass jar or crock. Next, cut the stems off, then one at a time salt the caps and press them into the bottom of the jar until some of the juice comes out. Salt, stack, and press them layer after layer until the jar is full. Let them ferment for 10 days or longer before trying. I made several batches, and I must say they were quite interesting and not acrid. I could eat them without any side effects. My only issue is that they were very salty — definitely an acquired taste. I'm sure they have medicinal effects as well, because besides their high content of immune-stimulating beta-glucans, they contain compounds that fight many kinds of bacterial and viral infections.

OTHER USEFUL POLYPORES

POLYPORES ARE A DISTINCT FAMILY — the Polyporaceae — in the group of basidiomycetes (mushrooms with club-shaped, spore-producing structures). They are characterized by diverse shapes and sizes, but generally they have hard or fibrous fruiting bodies that attack and consume wood. They produce and release spores from pores underneath their caps, unlike gilled mushrooms. Their spore prints are usually white to brown, when you can get them. (Polypores eject their spores based on weather, moisture, and length of day, and unlike fleshy fungi won't release them on demand after being picked.) The polypore conks typically discharge mega-amounts of spores at one time, which sometimes can be observed as a brown dusty layer on the top of the fruiting bodies.

RED-BELTED POLYPORE

Fomitopsis species

ABOVE: Polypores produce spores in pores rather than gills.

ABOVE: *Hapalopilus rutilans* is possibly the only polypore you shouldn't consume.

The fruiting bodies can be produced annually (such as reishi-like mushrooms) or grow layer after layer of tubes each year, becoming large and tough (as artist's conks do). They are often stemless and grow right out of the dead or dying tree they are

recycling. Some produce conks that are thick and like wood; others are thin and flexible (turkey tail). A few are tender and edible: maitake, beefsteak fungus, birch polypore, and chicken of the woods (*Laetiporus sulphureus* in the eastern United States and *L. gilbertsonii* and *L. conifericola* in the western United States.

Polypores are generally considered safe and nontoxic and can be used for medicine or food. One exception is the "tender nesting polypore," *Hapalopilus rutilans*. This species is widely distributed throughout the world. It grows on dead deciduous trees like oaks, forming groups of bracketlike fruiting bodies that are watery and soft when fresh. The color ranges from orange to orange and brown. The pore surface beneath the cap is yellowish shading to brown as it ages. There are reports of the mushroom causing neurological symptoms, possibly related to the polyporic acid it contains. The mushrooms can be dangerous if eaten in large enough quantities. It does not grow in the western United States, except very rarely on conifers. It is more common on hardwoods in the eastern United States. [137]

A Word about Dose

Tea extracts can be made from any of these species of polypores, except for the tender nesting polypore. The dose is the same, as they are all nontoxic. Mix ½ teaspoon of the tea powder in a little warm herb tea (like ginger) or water and drink one to three times daily, depending on individual need. Higher doses can be used, depending on need and tolerance. Ramp up slowly over a week to check for sensitivity, typically

gastrointestinal discomfort. If you do experience a little discomfort, try blending the powder into ginger tea. For the ground-up fruiting body, you can make a simple tea by simmering 1 part of the dry mushroom to 10 parts of water for one hour. Strain and drink a cup (again, you can add other herbs) one to three times daily.

For more information, I recommend reading the excellent review of the traditional uses of polypores in Europe in the article by Grienke and colleagues listed here.[138]

Red-Belted Polypore

Fomitopsis ochracea, F. mounceae, and F. schrenkii (until recently, these were collectively identified as F. pinicola)

Analytical studies of red-belted polypore have shown that the abundant triterpenes and beta-glucans in the mushroom extract have strong anticancer effects (specifically againt colon cancer), as well as antifungal activity.[139] The triterpenes have shown strong antibacterial effects, too. The water and alkali extracts (using diluted lye or sodium hydroxide water-based solutions) were found to have a strong antidiabetic effect, as well as the ability to increase insulin levels.

The red-belted polypore is widespread and grows on older Douglas fir and other conifers, especially in wet environments, such as near creeks. The fruiting body can be small to large and grows like a bracket on dead trees. The top of the fruiting body often has a red band around the outside of the margin, hence its name. The pore surface is white to light cream and does not

readily turn brown when scratched or bruised. The smell is sweet and characteristically fungal.

When making a tea, the fruiting body should be sliced or sawed into slices when fresh; when it dries, it becomes very tough, and a saw or stout clippers are necessary to cut through it. The slices should be boiled for an hour, then strained, and sweetened, if desired. To begin with, consume ½ cup twice daily. A tincture or double extraction can be prepared using a menstruum of at least 80 percent ethanol.

RED-BELTED POLYPORE

Fomitopsis species

Birch Polypore

Fomitopsis betulina

The birch polypore, as its name implies, fruits from living and dead birch trees (the Latin genus name for birch is *Betula*). They grow in Washington and Idaho, and in the eastern United States, where birches are native. The bracketlike fruiting bodies, which are whitish gray to brown, are rounded on top, have white pores, and are usually tender enough to break easily while still on the tree unless they are thoroughly dried. They emerge along the trunk of birch trees — both living and dead — as annuals with a new crop each year, unlike many polypore conks with fruiting bodies that are perennial and grow a new layer of spore-producing pores year after year.

According to the famous pioneer of American mushroom eating, Charles McIlvaine (whose book *One Thousand American Fungi* is a classic), tender young birch polypores are edible after thorough cooking. McIlvaine grew up in West Virginia, where food was still scarce after the Civil War. He started eating every mushroom he could find, and by the time he wrote his book, about 1900, he had eaten more than six hundred species, and did not die! At the time, the US Department of Agriculture report of 1885 said that only 12 species of mushrooms were edible. McIlvaine was quoted as saying, “I take no man’s word for the qualities of a toadstool. I go for it myself.” By comparison, I often feel very experimental after eating a hundred species of wild mushrooms.

The fruiting body and mycelium of birch polyphores have a complex chemistry with phenolic compounds, triterpenes, sesquiterpenes, and high levels of beta-glucans — up to 52

percent. Outside North America, birch polypore grows widely in Russia and eastern Europe and is reported to be used for its immune-strengthening and anticancer effects, its calming properties, and to address gastrointestinal problems. It is used externally as a powder or in a cream to treat skin infections. [140]

This species, formerly known as *Piptoporus betulinus,* has drawn a lot of research interest in the past 10 years because of its proven antibacterial, antiviral, and antifungal activity (against candida and others). The active components are better captured in an alcoholic tincture than in tea.

BIRCH POLYPORE

Fomitopsis betulina

ICEMAN, THE ANCIENT MUSHROOMER

When the 5,300-year-old mummy, now known as known as Ötzi the iceman, was found in the Tyrolean Alps, he had two types of polypores with him. On his belt was the birch polypore (*Fomitopsis betulina*), which contains agaric acid, an antiparasitic. He also carried a bag of tinder mushroom (*Fomes fomentarius*); it can be used medicinally (see Tinder Mushroom), but since the fruiting body is so fibrous when dry, it was historically used to sharpen tools and knives and as kindling for fires. We don't know if the iceman was actually using his mushrooms for medicine, but it we do know they were considered important enough to carry with him on his journey.

Tinder Mushroom

Fomes fomentarius

This hoof-shaped polypore fungus grows on both living and dead hardwoods, such as birch and maple. Long known as tinder fungus, it can be pounded with a rock to release its fluffy fibers. Traveling people from native groups in ancient Europe and western Asia would wrap hot coals inside the fungus and carry the bundle with them to start the next fire. The mushroom fibers insulate and have properties that kept the coal smoldering for a long time.

This fungus has been widely used in Asia and Europe to treat oral ulcers, liver problems, digestive problems, cancer, and various inflammatory diseases. Animal and cell culture studies show that it has anticancer and immune-stimulating properties. Other animal studies support an anti-inflammatory effect. Laboratory studies demonstrate that tinder mushroom extracts have an immunomodulating effect[141] and anti--inflammatory and pain-relieving action.[142]

The chemistry of the mushroom is well known and includes the usual high beta-glucan content of polypore mushrooms, along with alkaloids, phenolic compounds like flavonoids, vitamins, and minerals.[143] The fruiting body is too tough to eat, unlike the young birch polypore. To capture the immune--activating properties, cut up the tough fruiting body, preferably when fresh, then cook it for a couple of hours (or for 60 minutes in a pressure cooker) and blend it when cool enough. Make a dried tea extract, which will have very high levels of fungal beta-glucans for immune stimulation and prevention of infections. To capture the flavonoids, alkaloids, and terpenes, make a tincture or double extraction and take 2 to 3 mL (two or three droppersful) one to three times daily.

TINDER MUSHROOM

Fomes fomentarius

Quinine Conk

Laricifomes officinalis

Quinine conk was called *agarikon* by the ancient Greeks; it was also known as the panacea mushroom because they thought it could cure many diseases. Dioscorides, perhaps the most famous of all ancient Greek herbalists and author of *De Materia Medica* (in the first century CE), recommended it for treating tuberculosis and other infectious disease, as well as for treatment of poisonous bites and for counteracting the toxic effects of poisonous plants. From the time of Dioscorides until the 1700s, the fruiting body tincture and powder were kept in pharmacy shops and prescribed by physicians for

various ailments. Early physicians in the United States used the fruiting bodies for treating malaria and other infections.

This species has a complex chemistry which is now more thoroughly understood. [144] It has a number of triterpenes that have been shown to have antitumor and anticancer effects, and unusual chlorinated coumarins that are known to be effective against various flu strains, antibacterial, antifungal, and antiparasitic. The chemical and pharmacological work strongly supports the uses recommended by ancient physicians like Dioscorides.

Although teas and tea concentrates can be made from agarikon, tinctures with a high alcohol content might capture more of the antipathogenic activity because some of the constituents are not particularly water soluble. Teas are most effective when agarikon is simmered for at least two hours or pressure-cooked for 30 minutes.

The fruiting body is distinctive; it can live perhaps more than a hundred years, putting on one layer of pores after another. It can get very large, growing on old-growth conifers, especially Douglas fir that have been injured by lightning or perhaps disease. Since wild sources cannot be sustainably harvested to any commercial degree, cultivation of the mycelium is essential.

The quinine conk has one of the most interesting tastes of any mushroom. If you break off a piece and chew it a bit, you can identify, sweet, salty, bitter, sour, and spicy tastes all at once!

QUININE CONK

Laricifomes officinalis

PORCINI

Boletus edulis and other species

THIS IS MY FAVORITE MUSHROOM. In my mind, there isn't anything more delectable and exciting than finding porcinis on a mushroom foray. They are big and beautiful, and even the little buttons are so firm and tasty.

As delicious an edible as porcini is, it should also be considered a prime medicinal species because of its very high beta-glucan content. One analysis showed that the stem contains up to 57 percent beta-glucans and the cap contains about 17 percent.[145] This could be yet one more reason why porcini has been so revered in Europe and elsewhere, besides its wonderful taste and texture and its large, meaty fruiting body — eating it frequently can provide strong health benefits. A few laboratory studies show that porcini can kill human cancer cells and have an antioxidant effect.[146]

Porcinis are easy to recognize. They have a very bulbous stalk, usually with a netted pattern on the upper stem and very white pores (not gills). The cap can be tawny brown, dark reddish brown, or orange-brown; one species that is considered just as good as the brown ones has a white cap (*Boletus barrowsii*).

ABOVE: *Boletus edulis*

ABOVE: Finding a cluster of delicious porcini is always exciting.

ABOVE: Porcini's bulbous stem shows distinct netting.

Porcinis fall into the large group of boletes which are usually firm, small to very large, and have pores rather than gills. The fruiting bodies are usually symmetrical. The context (inner contents) is usually white, and some boletes have a bluing reaction when sliced or damaged. The bluing reaction can be a sign that the species is not edible — especially when the mushroom has a bulbous stature, a red cap, reddish pores and stalk, and reticulation on the upper stem (as seen in *Rubroboletus eastwoodiae*, *Neoboletus erythropus*, or

Rubroboletus pulcherrimus, which can be toxic). A notable exception to the bluing rule is the delicious, edible butter bolete. It has a bluing reaction, but the pore surface of a butter bolete is butter yellow, and the cap could have pinkish or reddish colors.

ABOVE: The toxic Satan's bolete (*Rubroboletus* species) has red pores and quickly stains blue when cut.

ABOVE: The edible (and delicious) butter bolete (*Butyriboletus appendiculatus*) also stains blue when cut; unlike Satan's bolete, however, it has butter yellow pores, not red.

Boletes have several closely-related look-alike genera, and of these, the genus *Suillus* are particularly common. These are also called slippery jacks or just suillus mushrooms. These tend to have a gooey or slippery cap when moist, no netting on the upper stem, but often have small resinous dots instead. Some *Suillus* species have felty tissue around the margin of the caps, which is also often slimy, and sometimes a felty ring on the upper stem. As a group, many suillus can be eaten, though they are not considered nearly as tasty as the best of the boletes and may cause gastrointestinal distress (especially if not well cooked). For me, it is a relatively safe genus that I cook up when

I can't find anything else. *Suillus pungens,* especially when young, is quite good. Some years I find troops of them.

Again, it is important to be sure of your identification before using a bolete for food or medicine, and try a few tablespoons the first time to check for individual sensitivity.

Some key tips for identification of boletes from other genera of mushrooms are the bluing reaction, cap color, pore surface color, netting on the upper stem, the shape of the base of the stem (club-shaped or not), and the taste. The taste of edible boletes is usually mild; some are bitter but not toxic. If the taste is very bitter or acrid when you touch it to your tongue, do not eat it unless you have a certain identification. Any red-pored, red stalked species that turn blue when cut should not even be tasted.

If the fruiting bodies are too full of fly larvae, then you probably want to reject them. Initially I was quite put off by mushroom fly larvae, but I got over that. If I see a few in a porcini after slicing it in half, I don't really care. One time I ate in a restaurant in Italy that served porcini in nearly every dish — raw marinated slices, soup, mushroom loaf, and porcini ice cream. When the slices came, I saw wormholes and called the waiter over to complain, and he said, "What are you complaining about, that is the best kind!"

ABOVE: *Suillus pungens* is an edible bolete relative. It's easy to identify by its green cap, tight white pores, and the milk it exudes.

ABOVE: Slippery jacks (*Suillus* species) have slimy caps and resin dots on the stem.

4

VISIONARY MUSHROOMS

The use of visionary substances is an ancient practice that has great healing potential, particularly when used

with respect and awareness of their ability to lift the spirit, expand consciousness, and explore other dimensions of existence. Benefits come from approaching this medicine with a sense of gratitude, wonder, and receptiveness. It helps if one uses this medicine with an openness to the teachings that can come during and after the experience.

AN ANCIENT PRACTICE, ILLEGAL TODAY

The idea and practice of ingesting visionary substances to temporarily dissolve the tyrannical or trickster ego, and to gain access to higher states of spiritual awareness, is ancient, likely going back at least 3,500 years. The ancients thought of all visionary plants and fungi as God-inducing substances.

Today, psychedelic mushrooms are classified by US federal law as Schedule 1 drugs: the same as heroin or LSD. This means they are considered by politicians, perhaps with the advice of some medically trained advisors, to have no currently accepted medical use and a high potential for abuse. This is unfortunate and, according to current research, not correct. (A few cities, however, are starting to decriminalize psychedelic substances, so hopefully the federal law will eventually change. See Denver Decriminalizes Psilocybin Mushrooms for details.)

Low Potential for Addiction

Research that compares the addictive potential of commonly used recreational drugs — including heroin, methamphetamine, caffeine, nicotine, and cannabis — has found that psychedelic mushrooms have the absolute lowest potential for addiction. Because of this, many people have criticized the law that lumps in psilocybin (the hallucinogenic compound obtained from fungi) with hard drugs. But published studies have demonstrated that in addition to having a low potential for addiction, psychedelic mushrooms offer beneficial effects for healing psychiatric

disorders, particularly for easing the existential crisis that may arise with some life-threatening illnesses, as well as depression and anxiety. Based on preliminary research findings, it may be that psilocybin can actually reduce opioid use and curb addiction, without causing major side effects or having addictive potential itself. This is something that is sorely needed.

The Therapeutic Effects of Consciousness Expansion

Many researchers who have studied the effects of hallucinogens have made the case that when we are free of our busy minds for a short time, we gain insights into our condition down here on planet Earth stuck in a human body. Research has shown that tribulations and psychological imbalances like depression and anxiety can be eased and even cured when we have a powerful spiritual experience associated with higher doses of LSD or psilocybin. These can serve as guides, and can help separate ourselves from our experience on the ground, if you will. With their use, we can sometimes be free of our ego for a time and gain real insights into our psychological problems, allowing time and space to see our plight and our symptoms and diseases more objectively. The realization comes that we don't have to identify and attach to symptoms such as chronic pain, both physical and existential, of cancer or other chronic diseases, which makes the pain significantly more bearable. Available research shows that the more profound the experience, the more healing can take place with intractable symptoms and diseases by connecting with a sense of oneness or spirit and feeling a sense of awe.

HISTORY OF USE

The consumption of hallucinogenic substances in ritual ceremony is thought to be about 3,500 years old, based on ancient texts, including the Vedas — ancient scriptures from India that date to about 1700 to 1100 BCE. The use of psilocybin was widespread throughout the cultures of Mesoamerica, including the Inca and Aztec. Murals that date from 500 CE depict fungi, and over four hundred chiseled mushroom stones have been unearthed in excavations of Maya sites. [1]

The first written reports of psilocybin use in Mesoamerica were from the early 1500s, from monks and later Spanish soldiers, writers, and others trained in cultural history who came over from Spain. Sixteenth-century historians, including Diego Durán, Bernardino de Sahagún, and Torbio de Benavente Motolinia, described their use in detail. They reported that the sacred mushrooms were called *teonanácatl* and served as guides to obtain prophetic visions. Priests utilized them, but healers also called on them to help divine the origins of their patients' illnesses. Warriors took them to gain courage and fearlessness in battle. The mushrooms had a rather unpleasant taste, so they were eaten with chocolate.

ABOVE: Celebratory stones from the Maya culture (about 2,000 years ago) resemble *Psilocybe mexicana.*

Twentieth-Century Identification of Psilocybin

Psilocybin mushrooms were identified and named by American and European scientists in the early part of the twentieth century. In 1938, Blas Pablo Reko, an Austrian-born medical doctor and ethnobotanist, and Richard Schultes, the celebrated ethnobotanist from Harvard University, collected three samples of "sacred mushrooms," which he deposited in the Harvard herbarium. In the late 1940s, a German mycologist named Rolf Singer (and later, Gastón Guzmán, a leading researcher from Mexico on the genus *Psilocybe*) identified one of the samples as *Psilocybe caerulescens*.

ABOVE: *Psilocybe caerulescens*

The American anthropologist Jean B. Johnson was the first outsider to observe the centuries-old shamanistic use of psilocybin mushrooms in southern Mexico in 1939.[2] However, the tradition was brought to the attention of the modern world by Gordon and Valentina Wasson. In 1955, photographer Allan Richardson traveled with Gordon Wasson to the hut of María Sabina, a Christian mystic and Mazatec *curandera* (healer) in southern Mexico, and the next day these two became the first Westerners to attend a sacred ritual, ingesting psilocybin and experiencing the beautiful chants and songs of Sabina and her daughter. They saw colorful and fanciful visions, which Wasson describes in his 1957 cover story in *Life* magazine as "more real to me than anything I

had ever seen with my own eyes." Two days later his wife, Valentina, and their 18-year-old daughter came and experienced the mushrooms as well.

For the second trip to Sabina's hut in 1958, Wasson was joined by Albert Hofmann, the synthetic chemist who discovered LSD. Wasson had sent him some of Sabina's mushrooms, and Hofmann had isolated what he thought were the active substances of the mushroom that induced visions and altered consciousness; he called these psilocybin and psilocin. He determined how to synthesize these two compounds and brought pills that contained them.

Hofmann gave Sabina two of the pills and asked if she would take them and confirm whether they provided a similar experience as eating the mushrooms. The story goes that all present ate two of the pills, then waited to start feeling the effects. (The effects of psychedelic mushrooms can usually be felt after just half an hour.) After an hour, Hofmann asked Sabina, "Do you feel it?" She shook her head, saying, "No, I feel nothing." So they all took another two tablets. After another 30 minutes, they all started to feel it, and after an hour, Sabina exclaimed they were very powerful and provided the same experience as the mushrooms themselves. It turns out that the active compounds more rapidly reach the blood and the brain when consumed as part of the whole mushroom, likely because they are more bioavailable. The tablets were slower but no less potent. In fact, because the participants ended up taking a double dose, the drugs were far more potent than what Sabina usually offered or took herself in the rituals.

After Hoffmann took the news of psilocybin back to the United States and *Life* magazine featured it in 1957, seekers from around the world inundated the villages of María Sabina and others in the area. This led to a lot of backlash and resentment directed at María

Sabina from other people in her region. Later, she said she could no longer conduct healing ceremonies with the mushroom because of what had happened. The mushroom spirit now "speaks English," she said. [3]

A SHAMAN'S DESCRIPTION OF THE PSILOCYBIN EXPERIENCE

There is a world beyond ours, a world that is far away, nearby, and invisible. And there is where God lives, where the dead live, the spirits and the saints, a world where everything has already happened and everything is known.

That world talks. It has a language of its own. I report what it says. The sacred mushroom takes me by the hand and brings me to the world where everything is known. It is they, the sacred mushrooms, that speak in a way I can understand. I ask them and they answer me.

When I return from the journey that I have taken with them, I tell what they have told me and what they have shown me.

— María Sabina, Mazatec healer from southern Mexico [4]

THIRD IN A LIFE SERIES: 'GREAT ADVENTURES'
SEEKING THE MAGIC MUSHROOM
A New York banker goes to Mexico's mountains to participate in the age-old rituals of Indians who chew strange growths that produce visions
By R. GORDON WASSON

ABOVE: This *Life* magazine article from May 13, 1957 introduced psilocybin mushrooms and María Sabina to the wider world. In the spread below, Gordon Wasson and Allan Richardson are pictured as they explore southern Mexico in the 1950s, and local species of psychedelic mushrooms from the genus *Psilocybe* are depicted.

PSILOCYBIN IN MODERN CLINICAL RESEARCH

From the time psilocybin was identified as the active compound in psilocybin mushrooms by Albert Hofmann in 1958 to the late 1970s, more than a thousand clinical papers were published on the effects and potential medical benefits of psychedelic mushrooms and other psychedelic substances.[5] The most compelling data coming out of these studies supported benefits for easing the existential pain associated with the end-of-life experience, for cancer patients, and for treating drug addiction.[6] These studies included close to forty thousand patients, and some preliminary evidence suggested benefits for these conditions with the use of LSD, psilocybin, and other substances.[7] Many of the studies were not well designed, and the results are often cited only as suggestive preliminary data encouraging more robust clinical trials.

The Research Door Reopens

The media circus and strong interest by the counterculture of the 1960s and '70s brought about government involvement, shutting down most formal research. Research licenses for human experimentation with these substances were pulled in the late 1970s, and the door wasn't reopened for any kind of formal research until 2006. At this point, research approval was reinstated on a limited basis, and seven clinical studies were conducted on cancer-related anxiety and depression, major

depressive disorder, obsessive-compulsive disorder, and alcohol and tobacco addiction. The findings were highly significant and positive, and the reduction in symptoms were higher than any other known treatment. Most of the studies included psilocybin doses along with psychiatric evaluation and standard therapy not involving medication.

RECENT CLINICAL TRIALS

At this point, clinical trials for psilocybin treatments are still in their early stages. The studies are summarized here only to provide information on the dose, study design, number of participants, and primary outcomes. Many of the studies included counseling interventions and supportive settings.

Remarkably, from the mid-1990s until 2016, approximately two thousand doses of psilocybin (ranging from low to high doses) have been taken by human volunteers in the United States and Europe.[8] These studies were carefully controlled and resulted in no reports of any serious medical or adverse psychiatric events, including no reported cases of prolonged psychosis or hallucinogen persisting perception disorder ("flashbacks").[9]

For the following studies, the dose varied from 18 to 30 mg if the volunteer's body weight was equal to or less than 155 to 165 pounds. For people with higher weights, the dose could increase by either 0.2 or 0.3 mg for each 2.2 pounds of body weight. A few studies used a low dose for the first session, then higher doses for the second. One study had four sessions with graduated and increasing doses starting at a low dose, and another used three sessions. (For details of all the studies, seek out the original review article by Thomas and colleagues cited here.)

Behavioral Disorders

In one open-label study (that is, one in which the patients are informed of the treatment they're being given), nine participants with obsessive-compulsive disorder were given increasing doses over four sessions about one week apart. Twenty-four hours after psilocybin dosages were given, symptoms were reported to be about 10 points lower than before the dose, according to the Yale-Brown Obsessive-Compulsive Scale. [10]

In a study on the effects of psilocybin on empathy and moral decision-making, 32 healthy volunteers received 0.215 mg/kg of body weight. Psilocybin significantly increased emotional empathy, but not cognitive empathy, compared with placebo. [11]

> Early preliminary studies strongly suggested that use of psilocybin mushrooms reduces symptoms of anxiety, depression, obsessive compulsive disorder, and alcohol and tobacco addiction better than any other known treatment.

Cancer-Related Anxiety and Depression

Twelve participants with cancer-related anxiety and depression randomly received one dose (0.2 mg/kg of body weight) of psilocybin or one of niacin (250 mg) as a control. Three weeks later, the doses were switched. Counseling was given after each session.

Of the 16 mood and psychological function scales used, including positive mood (plus other scales such as “positive derealization”), many were significantly elevated in the psilocybin group compared to the niacin group. Six months after all doses were taken, standard measures of depression were about nine points lower, and six points lower for anxiety, compared with before the doses were given. [12]

In a controlled, blind trial involving 29 people with cancer-related anxiety and depression, patients received one session of high-dose psilocybin (0.3 mg/kg) or a placebo dose of niacin (250 mg). Seven weeks later, the treatments were switched, so that every patient received both the psilocybin and niacin in a randomized order.

Seven weeks after the first dose, 83% of participants in the psilocybin group had a significant antidepressant response, compared to 14% in the niacin group. For anxiety, 58% had a significant reduction in symptoms, compared to 14% in the niacin group. On average, after six and a half months (at which point both groups had received psilocybin), antidepressant or antianxiety response rates were approximately 60 to 80%. [13] In other words, the antidepressant and anxiety-reducing effects were sustained more than six and a half months past the last psilocybin dose.

A study at Johns Hopkins Medical Center involved a randomized double-blind trial with psilocybin for reduction of depression and anxiety among 51 patients with life-threatening cancer. After three counseling sessions, totaling almost eight hours, the patients received either a high dose (22 or 30 mg/70 kg) or a very low dose of psilocybin (1 or 3 mg/70 kg) given in identical capsules. After five weeks, participants who had received a high dose were given a low dose, and vice versa.

High-dose psilocybin was associated with significant decreases in clinician- and self-rated depressed mood and anxiety, compared with the very low dose. After both groups took the high dose, they reported improved quality of life, life meaning, and optimism, including decreases in anxiety about dying. After six months, these changes were sustained, with about 80% of participants reporting clinically significant reductions in depressed mood and anxiety. Significant spiritual experiences were associated with favorable outcomes.

Major Depressive Disorder

Psilocybin was recently given a "Breakthrough Therapy" designation for major depressive disorder (MDD) by the FDA. Synthesized psilocybin was used throughout. This groundbreaking phase I study confirmed the safety and tolerability of psilocybin for major depressive disorder among 12 patients. In the open-label study with 12 volunteers with treatment-resistant major depressive disorder, patients were given 10 mg, then 25 mg of psilocybin in two sessions that were one week apart. One week after the last dose, standard measures of depression were 11.8 points lower. [14]

In a supportive setting with a guide, 20 patients (14 males and 6 females) with mostly severe, treatment-resistant major depression were given two oral doses of psilocybin (10 and 25 mg) seven days apart, as part of an open-label study. Depressive symptoms were assessed from one week to six months posttreatment. Relative to baseline symptoms, 13 of the participants experienced a marked reduction in depressive symptoms during the first five weeks. In follow-up meetings, the positive effects were still noted at three

and six months after the start of the study. No patients required conventional antidepressive treatment for the five weeks of the study. Results were better in cases where the psilocybin experience was more intense. The tolerability was reported to be generally good. [15]

Addiction Treatment and Recovery

In an open-label study, 15 volunteers with tobacco addiction received two doses of psilocybin (20 and 30 mg/70 kg of body weight). The first dose was on the smoking quit date and the second was two weeks later. Abstinence rates were still at 80% after 6 months and 67% after 12 months. Frequency of "transient strong fear" (intense fear that lasts only a short time) was 40%. [16]

Ten alcohol-dependent volunteers received two doses of psilocybin (0.3 mg/kg then 0.4 mg/kg) four weeks apart. The percent of heavy drinking days decreased from 25% at the beginning to about 9%, eight weeks after the first dose. This largely persisted for nine months. [17] As was the case with other studies, the intensity of the hallucinogenic experience was related to success in abstinence.

In an open-label pilot study, 15 smoking volunteers were given two to three moderate to high doses (20 and 30 mg/70 kg) of psilocybin, in combination with cognitive behavioral therapy (CBT) for smoking cessation. The treatment resulted in substantially higher six-month smoking abstinence rates than are known with other medications or CBT alone. At the 12-month follow-up, 10 participants (67%) were confirmed as smoking abstinent; at the 30-month follow-up, 60% were still abstinent. At 12 months, 13 of the participants reported that their psilocybin experience was

among the most personally and spiritually meaningful experiences of their life. [18]

Spiritual/Life Purpose

In one double-blind study, 36 participants took about 30 mg (for a 154-pound person, higher or lower for others) of psilocybin or Ritalin (a prescription nervous system stimulant) in two or three sessions. At two- to three-month intervals, participants randomly received either psilocybin or Ritalin. Volunteers had no experience with hallucinogens. They were advised to ignore outward stimuli and "go inward." After two months, the volunteers receiving psilocybin reported mystical experiences with a substantial spiritual significance that lasted and resulted in positive changes in attitude and behavior, confirmed by family and community members. [19]

One study centered on the ability of psilocybin to produce mystical-type experiences, and along with meditation and other spiritual practices, positively change behavior and psychological functioning. Seventy-five people were placed into three randomized groups, one receiving 1 mg of psilocybin per 70 kilograms of body weight, along with moderate-level support for spiritual practice ("standard" support); the second receiving high-dose psilocybin (20–30 mg/70 kg of body weight) with standard support; and the third receiving high-dose psilocybin with high support. Psilocybin was administered one and two months after support was given. Compared with low dose and standard care, at six months both high-dose groups showed large, significant, positive changes on measures of interpersonal closeness, gratitude, life meaning and purpose, forgiveness, death

transcendence, daily spiritual experiences, religious faith and coping, and community observer ratings (given by three observers who knew the participant well). [20]

In a randomized, double-blind, placebo-controlled study with 38 participants, a single oral dose of psilocybin (315 mcg/kg) was given during a five-day mindfulness retreat. The extent of ego dissolution and brain connectivity was linked to positive changes in psychosocial functioning of participants four months later. Psilocybin was seen to serve the beneficial processes of meditation by acting on the default mode network [21] — a group of interacting brain regions that is the basis for self-awareness and how we think about ourselves.

Cluster Headaches

In one study in the Netherlands, 756 people received a questionnaire for a research study on the lifetime use of "illicit" drugs. Respondents who reported experiencing cluster headaches were 8 percent more likely to use illicit drugs. Those who used psilocybin reported a reduced attack frequency of 56 percent. [22]

Neurogenesis

Psilocybin has a number of identified, complex physiological effects on the brain and nervous system. [23] One of the most fascinating effects with emerging research interest is the ability of low-dose psilocybin to stimulate neurogenesis — the growth of nerve cells — perhaps in a different way than lion's mane (*Hericium erinaceus*) does. Psilocybin has several demonstrated

effects on mice. Regular low doses can stimulate the growth of new neurons, but high doses have the opposite effect. This implies that large doses should only be used for therapeutic sessions with rests in between, and not for regular or frequent use. The effects of neurogenesis were noted in the hippocampus and had the effect of reducing the brain's fear response, raising interest in testing it as a potential treatment for those suffering from post-traumatic stress disorder (PTSD). [24]

STANDARD DOSES AND PREPARATION

The usual beginning mild oral dose (based on a review of the literature and firsthand reports of microdosing) can be 0.4 to 1 gram of dried mushroom, depending on your sensitivity, previous experience, and species being used. If you are trying psilocybin for the first time and consider youself sensitive, you might start with about ½ gram of dried mushroom of *Psilocybe cubensis* (the most commonly cultivated species). That will give you about 3.5 mg of the psilocybin and psilocin alkaloids. A number of researchers have reported that an oral dose of 8 to 25 mg is typically well tolerated and safe for most people (again, depending on your sensitivity and body weight). [25] For therapeutic uses for mood disorders, addictions, or existential crises (with the assistance of a guide), the dose is typically 20 to 30 mg/70 kg (154 lb.) of body weight.

If you are judging the dose based on dried mushrooms, remember to consult the Psilocybin and Psilocin Content of Various Species chart and calculate the approximate dose of

psilocybin alkaloids. Since dried mushrooms are from a natural source, the amounts will vary and are only an approximation.

THE POTENTIAL DANGERS OF HIGHER DOSES

In studies throughout this chapter, participants who took even a single high dose of psilocybin experienced lasting psychological benefits. When they took their dose, however, participants were under close supervision by medical professionals and had been screened for medical and psychological issues. They were in a carefully controlled environment and were unlikely to harm themselves while they were in an altered state.

Anyone who takes a high dose of psilocybin while they are not supervised has the potential to cause themselves harm, if only because they may not be aware of their surroundings. Anyone with existing medical issues — being at a high risk for heart attack, for example — could also be harmed by the experience. Those who suffer from severe depression or other psychological disorders simply should not take high doses of psilocybin while unsupervised.

Psilocin Content Varies

The psilocybin and psilocin content of the mushrooms varies considerably depending on the species, how long ago each one was

picked, how it was stored, and for how long. For the most commonly cultivated species, *Psilocybe cubensis*, the psilocybin and psilocin content is about 0.5–0.7 percent (see the Psilocybin and Psilocin Content of Various Species chart). Five grams of dried mushroom × 0.005–0.007 = 25–35 mg of active compounds. This would be a high dose. If you are using *P. semilanceata*, you could get up to double that amount; for *P. azurescens* or *P. cyanescens* you could get up to four times that amount. Remember that the effect of any dose is also dependent on your weight and size, and how you metabolize psilocybin.

If you are not sure of the species or the age of the sample you are eating, start with a dose of 1 to 2 grams of dried mushroom. If you are sensitive, 1 gram will be best. One gram of even the most potent species — which could have around 2 percent (0.02) psilocybin and psilocin, or 20 mg of the active compounds — would still be considered a high dose. However, if you are eating mushrooms from a friend or a local seller, you will likely have *P. cubensis* at 0.5–0.7 percent, or 5–7 mg of active compounds, a low dose.

Finally, keep in mind that you will not likely absorb all the active compounds from dried mushrooms. Not all the psilocybin and psilocin will come out in the tea, and after eating dried mushrooms, some will not be absorbed and will be eliminated by the body. So overall, the effects might be milder than expected, especially if the dried mushroom material is old or hasn't been stored properly. The bottom line is that because this is a natural material and not a purified compound, results will vary. That's why I recommend starting with a low dose and increasing it as needed, or making the liquid extract below.

Keeping dried mushrooms in the freezer until use will keep them potent for a longer time. They can be eaten dried and

powdered in a small cup of chocolate drink like the ancient Mesoamerican people did, or make a simple tea by simmering the mushrooms for 10 to 15 minutes, straining and drinking the tea once it has cooled. However, the heat can decrease the psilocybin content. You can also just chew up the dried mushrooms and swallow them, but this is the least pleasant way to take them. They can be gritty and tough, and the taste is strongly of earthy mushrooms.

LIBERTY CAP

Psilocybe semilanceata

Toxicity and Side Effects

Studies show that psilocybin has the lowest dependence potential of any recreational drug, and its acute toxicity is low. In 2011, a study on the safety of psilocybin mushrooms was sponsored by the government of the Netherlands (where at least one city — Amsterdam — allowed for the legal use of psilocybin mushrooms).[26] The researchers of the study reviewed available data on tens of thousands of people who had used psilocybin mushrooms. They noted the most common side effects of ingestion of psilocybin mushrooms as an increase in heart rate and breathing rate (about 10 to 12 percent greater because of a mild stimulation of the sympathetic nervous system), and other symptoms such as anxiety, dizziness, nausea, and vomiting; more rarely confusion, thought disorder, and headache. These last symptoms were reported in about 25 percent of 138 patients in the seven clinical trials they reviewed, but the effects were typically transitory, or resolved after the effects of the psilocybin was no longer present, often about six hours.

These reported side effects were especially true with the higher doses over 15 milligrams of psilocybin. Many of the symptoms were transitory, but the concomitant use of alcohol with psilocybe mushrooms increased the rate of side effects. The researchers found that the physical and psychological dependence potential for psilocybin was the lowest of all drugs they reviewed, and concluded that the public health impact, including the potential for criminal activity, was negligible.

Cautions for Use

Although there are some risks for individuals with an existing psychological condition — in other words, you could have a “bad

trip" — existing studies and reports from widespread use have led to few actual published case studies showing psychological injury as a result of using psilocybin. If a patient has a preexisting psychological or medical condition, it's best to be cautious and find an experienced guide to work with rather than working with the mushroom alone (see Find a Guide to Work With for more on using a guide). Caution is also advised for patients using prescription medications, especially if those drugs work on the nervous system in some way — for instance, antidepressants or anxiolytics like benzodiazepines. People with suicidal thoughts definitely need to be under the care of an experienced guide, preferably someone who has formal training in psychology. Concomitant use of alcohol, other recreational drugs, or monoamine oxidase–inhibiting drugs (a prescription drug sometimes used for depression and panic disorder) is also discouraged, as is driving any kind of vehicle.

LIBERTY CAP

Psilocybe semilanceata

Microdosing

Microdosing is the idea that psychotropic drugs and mushrooms can be used daily, or at least frequently, to enhance creativity, to calm anxiety, to ease depression, or to gently turn sadness to joy. It can also help people gain insights into everyday challenges, or even reduce cravings for addictive substances.

Anecdotal reports coming out of Silicon Valley say that microdosing with LSD or psilocybin has become widespread in some work environments, especially to enhance creativity and

imagination: It's considered "a productivity hack." Many people post about their experiences with microdosing online (see Resources). One such person is a graphic designer, producer, and musician with the pseudonym Johann. He has microdosed psilocybin twice weekly for about three years and reports that it sharpens all his senses and makes him a little more conscious. His dose is 0.4 grams, and he says that higher doses can be disruptive to his daily flow of work, causing him to become excessively philosophical or laugh too much.

BEWARE OF SYNTHETIC PRODUCTS

It's important to remember that psilocybin mushrooms are not the same as street drugs that are reported to contain natural psilocybin. These white powders and random capsules could contain all kinds of chemical solvents and by-products of chemical synthesis. With mushrooms, no added solvents, industrial chemicals, or nasty surprises. You know that you at least have a natural product that contains only psilocybin and psilocin. You should only buy mushroom products from someone you know well, who is an experienced grower or expert forager.

STEP BY STEP:

EXTRACTING PSILOCYBIN FROM MUSHROOMS

An alternative to consuming powdered *Psilocybe* is to extract the psilocybin in a tincture and take it sublingually, by the dropperful or by spraying it. The alkaloid is soluble in hot water and ethanol. I recommend extraction with a 50:50 blend of water and ethanol (grain alcohol) or 100 proof vodka. If you use vodka instead of ethanol, no water is necessary. Be aware that too much heat can degrade the active compounds.

1. If the mushrooms are dried, soak them for several hours in a little water, then add 100 proof vodka and blend them thoroughly with the menstruum (soaking liquid) until no large particles are evident.

2. Transfer the mixture to a canning jar. After the mushroom mass settles, add enough additional alcohol to cover the mushrooms with an inch of liquid. Take a chopstick or butter knife and stir the maceration to make sure no air bubbles are trapped.

3. Wrap the jar in a heating pad overnight, at about 95˚F/35˚C. Turn it off during the day, then turn it back on for a second night. In the morning, blend the mixture again.

4. Strain out the solids, then press out as much liquid as possible through a coffee filter or fine-mesh nut-milk bag. (You can

extract the mushroom marc a second time, just as before, but this extraction will be far less potent.)

5. Pour the liquid into a 1-ounce or 2-ounce bottle with a drug delivery spray top. For microdosing, select a spray top that delivers 0.1 mL with each press of the top. Store the liquid in the refrigerator.

DOSAGE FOR MICRODOSING. Start with three to five sprays, which will be the same as ⅓ to ½ of a standard dropper. You should feel this dose as a lift in mood that lasts several hours. Some feel that it can increase creativity and provides other benefits. Some people that I have monitored with this preparation felt that one full dropperful (10 sprays, sublingual) is best for microdosing and they didn't notice five sprays very much. For others, even more sprays will be necessary to feel the effects of a microdose.

WHAT TO EXPECT FROM THE EXPERIENCE

If you've never tried a dose of psilocybin mushrooms, it's reassuring to know more about the feelings and reactions you can expect during the session. However, sensations and experiences vary depending on many factors — the dose, the species, your metabolism, how your nervous system functions, your present psychological state and mood, the setting, how much you have eaten that day, and other factors.

After eating psilocybin mushrooms, I remember feeling a slight shift in my mood and perhaps a slight physical sensation of

recognition that something is just a little different. Perhaps receptor sites in the mouth or esophagus are already activated. (Since psilocybin is a serotonin receptor agonist — it binds to and activates the receptor — it's interesting to note that 90 percent of the serotonin receptors in the body occur along the alimentary canal, including the mouth.) This initial feeling is mild, however, and soon passes. In many people, yawning and sleepiness seem to be common after 15 to 20 minutes, which slowly shift to a feeling of euphoria or just a pleasant feeling of stimulation, both physical and mental, and even happiness. You might laugh at the most mundane things. At this stage, you may also feel some apprehension or anxiety; with high doses (20–30 g) you may even have a short period of panic, especially if you've never ingested psilocybin before.

With a low dose, this is all you might feel — enhanced mood, and various mild to moderate body sensations. With higher doses (at 10–15 g and especially 20–30 g), you will likely feel perceptual changes, perhaps some disorientation or excitement, going on to more and more visual patterns and colors shifting and moving across your inner vision. With a high enough dose, you should be able to close your eyes and still see colored patterns changing and shifting. You might see figures, faces, animals, even fantastic scenes like a waking intense dream.

Some folks report having profound spiritual and revelatory experiences that can last for months, even years. Many under the influence of psilocybin mushrooms connect with a sense of oneness with "spirit," to feel a sense of awe (many report this), or to have profound feelings of gratitude and a lack of separateness, loneliness, and isolation. Other responses people have reported during a psilocybin experience include increased body

temperature, pupil dilation, muscle weakness, individual hair erections, and spontaneous laughter.

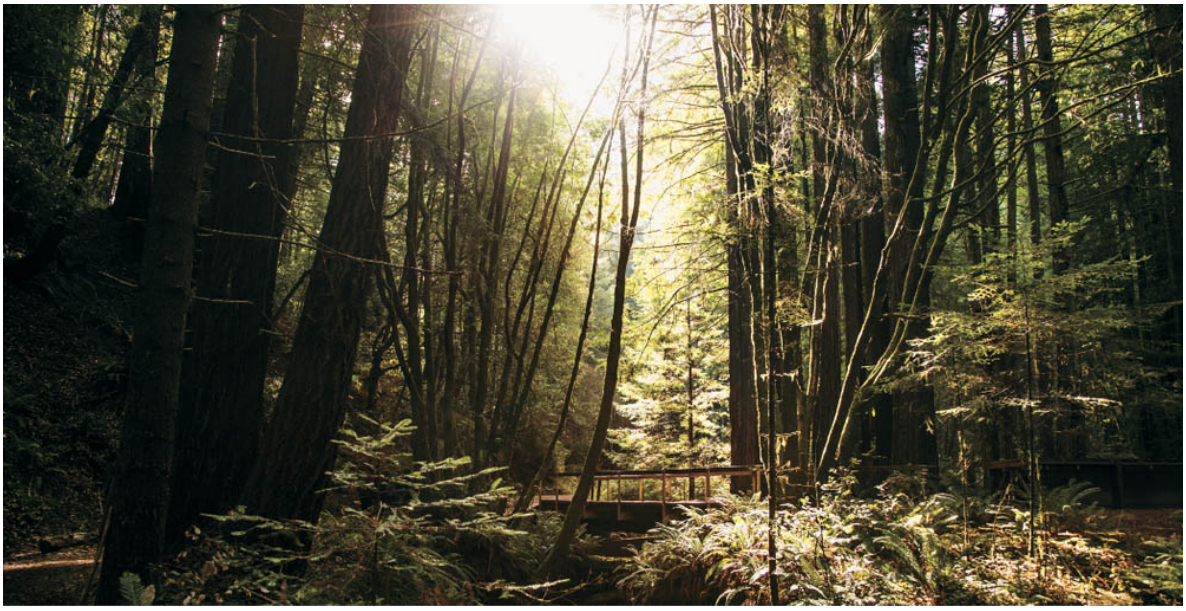
> Finding a knowledgeable guide to help you navigate the experience is key.

Find a Guide to Work With

Working with a guide is essential, especially for patients with preexisting psychological conditions. During a journey, anxiety and scary or depressing thoughts can occur. If you're having a bad trip, the guide is there to reassure you and lead you back into the journey. An experienced guide knows what to do and can change the environment — the lighting, music, visual imagery, amount of fresh air — and talk with you in a reassuring way. Sometimes, even just having a close friend hold a healing space for you is helpful.

It's especially important to have an experienced guide if you're going through times of psychological, emotional, and physical stress; the journey is much more likely to become unpleasant or scary. Research shows that the psilocybin can provide great insights during these times, even help heal depression, anxiety, addiction, and other emotional and psychological ailments. The guide can provide reassurance if you come to a place in your journey that is frightening or not productive, such as when negative thoughts get out of control. I have experienced this first-hand and was very grateful to have someone assist me when I lost my way. Experienced therapists, counselors, and psychologists can

listen to your experiences and feelings after the journey has ended and reflect back to you important truths and reinforce your most positive insights.



ABOVE: Some people who take psilocybin in a natural setting experience feelings of greater connectedness to the natural world around them.

Consider the Setting

The place where you ingest visionary substances — your social and physical environments — is known as the setting. In the psychedelic community, "set" is short for "mind-set" or how you're feeling when you partake of psychoactive substances. Time and again, well-known thought leaders in the psychedelic movement have emphasized the importance of "set and setting" as factors that help determine the quality and benefits of a psychedelic experience. These factors are important to one's success for

healing, and for how you will weather the changes that will happen in your mind and psyche during the experience.

For example, when I was younger, foraging psilocybins along the Oregon Coast (see My Own Experiences), I always wanted to go out and have an experience in the forest because the forest community was where I felt my major allies of the natural world were. I didn't feel comfortable taking larger doses in big crowds of people because social interactions can be more intense after ingesting psilocybin. Also noise, lights, and the vibrations of people during a psychedelic experience can be quite distracting.

IDENTIFICATION OF ACTIVE GENERA

Psilocybe, *Conocybe*, *Gymnopilus*, and *Panaeolus* are all genera of wild mushrooms that contain some amount of psilocybin. However, some of these have related species that are quite toxic – even lethal. For this reason, it's safest to use only positively identified *Psilocybe* species for visionary purposes.

Psilocybe species

Members of the genus *Psilocybe* are typically small to medium saprophytic fungi. The cap is often viscid (slimy and sticky) and brown when wet; in some species, the cap becomes a light yellow when dry. It has an easily peeled pellicle, or skin, on the top of the cap. The stem is variable; some have stalks that are quite thin (*P. semilanceata*) and some that are thicker (like *P. cubensis*).

ID TRAITS. The mushrooms can be brown, gray, or yellow; the gills are brown (light brown when young, maturing to a deep purple-brown) and are attached to the stem. The stem can be buff to brown and slender to somewhat thicker. For instance, *P. cyanescens*, a common species found in the wild in coastal areas of the Pacific states, has a stem that is 3 to 6 mm wide and 30 to 80 mm long. *P. semilanceata* is typically 2 to 3 mm in diameter and 40 to 100 mm long, whereas *P. cubensis* has a thicker stem, up to 18 mm wide and 70 to 120 mm long. The spore print is purple or purple-brown or sometimes darker. You might see a felty ring on the upper stem, which is a bit of tissue that degrades as the cap opens. The stems of some species will show a bluing reaction at the base, particularly when crushed or bruised. The bluing is a result of psilocin degrading, so species like *P. semilanceata*, which rarely contains psilocin, won't have a bluing reaction.

HABITAT. Some species of *Psilocybe* grow in cow dung — primarily *P. cubensis*. Other species covered in this book, such as *P. semilanceata,* grow on rotting sedges and grass in the presence of some dung, typically in pastures where cows graze or deer are present. Some, including *P. azurescens* and *P. cyanescens,* grow on degrading wood chips in gardens. I've even found them in potted plants that had been mulched with wood chips. These two species, along with *P. stuntzii* and *P. baeocystis,* also grow on degrading grass where bark chips meet the grass. When considering fungi that grow mainly on wood chips, be particularly careful of species in the genus *Galerina* — especially *G. autumnalis* and those in the *G. marginata* group. These species, which have brown spores, can be deadly.

Sometimes fruiting bodies are abundant and grow in large quantities. The common species *P. semilanceata* grows in boggy

coastal pastures where sedges are present and is easy to see and identify when it dries out. When wet, the fruiting bodies kind of blend in, but once they dry, they're easy to spot; you can see the contrast of the golden yellow caps in the grass.

Avoiding Look-Alikes from Other Genera

A crucial point that bears repeating — especially when it comes to psychoactive mushrooms — is not to consume any mushroom from the wild unless you are sure of its identity. There are several common species that may be found growing near psilocybin species; some of them look similar to psilocybins but may be toxic or even lethal.

Learn the toxic and potentially deadly ones first, so that you know what to avoid. Many good websites and field guides with pictures are available for every region of the United States, and there are ones that focus exclusively on psilocybin mushrooms. See Resources for a list of recommended titles and websites.

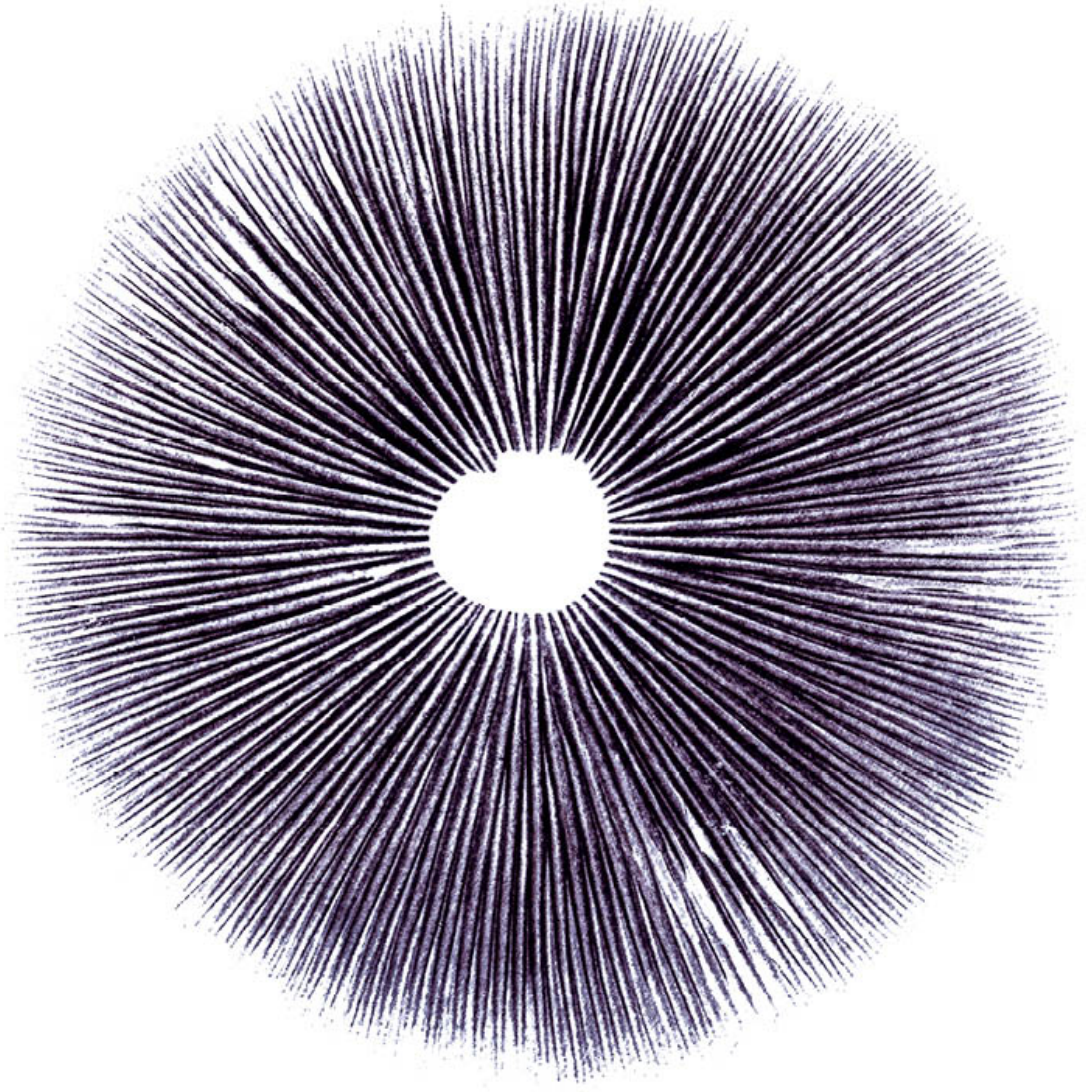
ABOVE: *Psilocybe azurescens* (left); *Psilocybe baeocystis* (right)

ABOVE: *Psilocybe cyanescens* (left); *Psilocybe cubensis* (right)

AVOID MUSHROOMS WITH BROWN OR BLACK SPORES. A spore print may be the most helpful identifying characteristic because if the spores are any shade of brown except purple-brown, the mushrooms can be rejected out of hand; psilocybin spore prints will be purple or purple-brown. Genera with brown spore prints include the potentially lethal *Galerina* genus and other small mushrooms that can grow near psilocybin species, especially *Conocybe* and *Inocybe* species. These are common species that can look similar.

Mushrooms with a dark (black or dark purple) spore print of smaller stature growing near *Psilocybe* include members of the genus *Panaeolus* (brown-black to black), *Coprinus* (deep brown to black), *Psathyrella*, *Hypholoma* (deep brown to purple-brown but sometimes cinnamon brown), and *Stropharia* (very dark brown to

purple-black or black). However, while members of these genera can be toxic and cause nausea and vomiting, these brown-black to black-spored fungi are not as potentially dangerous as some of the brown-spored look-alikes, such as those from the genera *Galerina* and *Conocybe*.



ABOVE: *Psilocybe cubensis* spore print

All *Psilocybe* species have spores that are some shade of purple — perhaps dark purple or purple with a little brown — but not all purple-spored mushrooms are *Psilocybe* species.

LOOK FOR BLUING. Another key characteristic of most, but not all, psilocybin species is the bluing reaction, especially on the bottom of the stem when picked. When the mushroom is handled, bluing can also occur on the cap or other parts of the stem. You won't find this reaction in any look-alike species. Do not depend on bluing as the sole indicator for identification, however; you will find toxic *Inocybe* species with blue at the base of the stipe.

LOOK FOR OTHER KEY TRAITS. When you examine the spore print of a species in one of the genera mentioned above, it's important to consider the mushroom's other traits as well. (See Key Characteristics of Psilocybe Species.)

PSILOCYBIN AND PSILOCIN CONTENT OF VARIOUS SPECIES

The amount of active chemicals varies greatly by species. If you choose to try psychoactive mushrooms, it's best to start with a very small dose and work your way up. Starting small is also a good plan because of the potential of mistaking them for toxic species. Note that all species of *Psilocybe* have spores that are some shade of purple.

SPECIES	PSILOCYBIN PERCENTAGE	PSILOCIN PERCENTAGE	NOTES
Gymnopilus junonius (syn. G. spectabilis) and 13 other species reported to contain psychoactive constituents are widespread	0.34	0.29	"Big laughing gym" is one common name (perhaps for obvious reasons); medium-large clusters of fruiting bodies occur at the base of dead trees or stumps. Supposedly species of the genus that

			grow in the western United States, such as G. ventricosus (western jumbo gym) are devoid of psilocybin, while in the eastern states some species contain it. Orange to rusty brown spore print
Psilocybe azurescens	1.78	0.38	Often cultivated on wood chips; grows spontaneously in regions of the Pacific Northwest that have wet summers
Psilocybe baeocystis	0.45–0.85	0.59	Once common throughout the Pacific Northwest;

			reportedly rare now. Grows on bark chips
Psilocybe caerulescens	1.46	—	Common and widespread in the southeast United States into Central America
Psilocybe cyanescens	0.45–1.0	0.09–0.36	Common in coastal areas of the Pacific states; grows in bark mulch around parks and gardens
Psilocybe cubensis	0.25–0.45	0.2–0.4	Commonly cultivated; grows in the tropics, the southeastern United States, and Hawaii
Panaeolus cyanescens (syn. Copelandia cyanescens)	0.32	0.51	Widespread in tropical and neotropical areas of both

			hemispheres; black spores
Psilocybe semilanceata	0.96–0.98	—	Called liberty caps, these grow in Europe and in the United States; common in cow pastures in the Pacific Northwest

All spore prints are some shade of purple unless otherwise noted.

Some species of *Conocybe* and *Inocybe* also contain small amounts of psilocybin, but the genera contain many toxic look-alikes. No species of *Conocybe* or *Inocybe* should be consumed.

Source: Tylš et al., 2014; Heim et al., 1965.

KEY CHARACTERISTICS OF *PSILOCYBE* SPECIES

When identifying mushrooms, you should note a combination of characteristics and not depend on just one trait to make a positive ID. For instance, with members of the genus *Psilocybe*, the combination of characteristics to identify are:

- **SPORE PRINT.** Spores should be some shade of purple (could be purple with a little brown or black, or lighter).
- **BLUING REACTION.** The bottom of the stalk, the upper stem, or the cap may turn blue when bruised.
- **EASY TO PEEL SKIN.** The pellicle (tough, stretchy skin) can be peeled from the top of the cap. (Do not use this as the sole identifying trait, however; one of the deadly *Galerina* species also has a peelable cap.)
- **FOUND ON THE GROUND.** They grow in pastures, on bark mulch, or in the soil under trees in the forest, but not *on* the trees.

ABOVE: To accurately identify a species, use as many characteristics as possible. In this case, the purple spore print indicates a *Psilocybe* species.

LEGENDARY *AMANITA MUSCARIA*

Amanita muscaria — also known as fly agaric because of its purported traditional use for attracting and killing flies — is a mushroom of many faces, if you will. Because of its psychoactive compounds, fly agaric has been (and is still) used in shamanistic rituals, especially in the far east of Russia, where intact indigenous cultures continue to practice some of the ancient ways. It does not contain the same lethal toxins as other species in the genus, such as *A. phalloides* — but it can produce very toxic effects. Interestingly, because the toxins are water soluble, the mushrooms can be also be rendered edible if properly leached (see Can Fly Agaric be Eaten Safely?).

However, eating the leached and cooked mushroom or using it for visionary purposes is not without risk — especially if your identification is not 100 percent accurate. The toxins present in *deadly* species of *Amanita* are amatoxins, which are not water soluble and are neither removed by leaching nor destroyed by heating.

I have not partaken of fly agaric for visionary purposes because I'm concerned about potential stress to the liver (although there is no published research to support the idea of hepatotoxicity) and because ingesting it can cause nausea and vomiting. Of the informants I interviewed who had extensive experience with the mushroom and recommended it, one or two didn't look very healthy. And according to one source, the mushroom is apparently lethal to cats and dogs. [27]

ID TRAITS. The red, yellow, or orange-and-white cap with white to yellowish white warts that easily rub off (or wash off in the rain) makes *A. muscaria* one of the most noticeable of all mushrooms. The white dots on the cap, as well as the thin triple ring surrounding the base of the stem (called the volva) are all parts of the original "universal veil" that completely surrounds the fruiting body when it is still submerged and in its infancy. When the cap expands, the universal veil does not expand; instead, it breaks up into the white dots you see on the cap, as well as the triple ring of tissue at the very base of the stem. Because all young *Amanita* species look like a white egg, it's a good idea to cut any puffballs you find in half if you plan on eating them to make sure a small mushroom is not hiding inside.

Fly agaric is widespread and forms mycorrhizal associations with a number of conifer species around the Northern Hemisphere. At times, one sees massive fruitings from California across the northern United States, and in many other countries.

Folklore and Fairy Tale

In the book *Alice's Adventures in Wonderland*, this was the mushroom upon which the caterpillar sat, offering pieces to Alice, saying, "One side will make you grow taller, and the other side will make you grow shorter." In Siberia, fly agaric fruiting bodies were ingested for recreational purposes, to become inebriated for gatherings and revelries. The caps are stronger acting than the stems, so they were used exclusively. They were dried and powdered and added to drinks, made into teas, or consumed fresh.

The symptoms reported 30 to 60 minutes after ingesting them included drunkenness, shaking of the extremities, and

hallucinations. The visions could be terrifying or happy depending on the present condition or temperament of the user. Some folks would jump, dance, or cry out. Supposedly, those who took a small quantity experienced a feeling of extraordinary lightness, joy, and courage and a sense of energetic well-being.

ABOVE: *Amanita muscaria*

ABOVE: In *Alice's Adventures in Wonderland*, the caterpillar offered Alice pieces of fly agaric to eat.

WAS SANTA CLAUS A SHAMAN?

The Santa Claus legend is a fascinating one that some have ascribed to shamanistic practice based on an *Amanita muscaria* cult. The story goes that Santa Claus was a shaman who used *A. muscaria* for divination and shamanistic uses. For instance, the Santa Claus suit is red with white trimming, similar to the fruiting body of fly agaric. Do reindeers really fly? Why does Santa say “ho-ho-ho,” as one might do after consuming fly agaric? The fungus is common all over northern Europe. It is possible that ancient shamans from Scandinavia and Siberia, or other northern European countries, used *A. muscaria* for divination, just as is done in isolated pockets of eastern Siberia today. It makes an inviting story for fungal enthusiasts, but one not likely related to the origins of the Santa Claus legend, which originated in Turkey (St. Nicholas lived around 280 CE) and developed further in Germany.

ABOVE: From *Icebound on Kolguev* by A. Trevor-Battye, 1895

The Downsides

There are some nasty side effects when fly agaric is consumed, however. Nausea and vomiting are not uncommon. If enough mushroom is consumed, the consumer may enter a deep, comalike sleep during which nightmares can be vivid, including changes in time perception and in size perception. In severe cases, the comalike sleep can last up to 72 hours; at least one death occurred because the victim consumed the mushrooms outdoors in the cold and froze to death while in the comalike sleep. Unlike psilocybin and psilocin, there is a very narrow dose-response curve. In short, it is easy to overdose.

Active Compounds

The three most important identified compounds shown to have distinct psychological effects are the alkaloid muscarine, as well as muscimol and ibotenic acid. All three of the active compounds in the mushroom are readily water soluble and eventually pass out of the body through the urine. Most of the active compounds are in the red skin on the top of the cap, along with the yellow tissue beneath, which is why the mushrooms are peeled (then leached) before being eaten for food (see facing page for more about this).

MUSCARINE. This powerful stimulant of the parasympathetic nervous system causes such symptoms as tearing up of the eyes, profuse sweating, slower heart rate, blurred vision, vomiting, and abdominal pain, depending on the dose. Because of the effects of muscarine on the smooth muscle of the body — airways, gastrointestinal tract — it also affects the bladder and circulatory system. Fortunately, *A. muscaria* typically contains only a small amount of muscarine, often around 0.0003 percent by fresh weight.

Amanita pantherina and mushrooms from other groups — including *Inocybe*, *Conocybe*, *Clitocybe*, *Mycena*, *Entoloma*, and *Omphalotus* — contain muscarine in much higher amounts and should be strictly avoided.

IBOTENIC ACID AND MUSCIMOL. These are closely related compounds to which the psychogenic effects are ascribed. They affect the central nervous system by efficiently binding to certain GABA receptors, as well as glutamic acid receptors. The effects of these compounds are variable depending on the person and on

variability in the chemistry of mushrooms from different populations around the Northern Hemisphere.

As little as one medium-sized cap (15 to 20 cm across), either dried or fresh, is often enough to produce psychotropic effects, but the chemistry changes with the stage of development and the time of year it is collected. Cooking or heating doesn't seem to reduce the potency if the mushroom is consumed along with the water when boiled, or if it's drunk as a tea. Reactions can start after 30 minutes, sometimes longer, depending on whether the stomach is full or empty. Aggressive attitudes are not usually produced in the user.

Can Fly Agaric be Eaten Safely?

A number of years ago, David Arora, author of *All That the Rain Promises and More*, taught a group of us to prepare fly agaric, so as to render it safe to eat with no psychogenic effects. It is first necessary to peel the cap (which contains more of the active compounds), simmer the slices in water for 20 minutes or so, then drain off the water. The active compounds are water soluble; to be absolutely certain of removing them all, a brief second simmering can be used. The leached slices are then stir-fried in olive oil with a pinch of salt. (For more information, see the article by Rubel and Aurora listed in References.)

This process is not advised for beginners. The quantity of hallucinogenic and toxic compounds varies by season, region, and level of maturity, introducing the risk of not leaching the mushrooms long enough to remove all the toxic compounds. And even people who have leached and cooked the mushroom occasionally have unpleasant side effects.

MY OWN EXPERIENCES

When I was younger, some friends and I used to hunt psilocybin on the Oregon coast, in cow pastures where they grew abundantly. The most common species we found was *Psilocybe semilanceata*. They were so abundant, we had to freeze them to prevent degradation of the psilocybin and psilocyn.

I spent many beautiful hours in old-growth forests and elk pastures, wandering and watching the life — the insects, birds, trees, and green plants — unfold in the natural way of things. My

guides were the plants and trees and waters I frequented while using the sacred mushrooms during major journeys.

I ingested psilocybin mushrooms by both microdosing and macrodosing. I microdosed for nine months at one point, and I noticed after a month or so I was smiling most of the time and feeling more open to life and its constant changes.

Looking back, this was an important element in my maturation and development of some wisdom as a pretty clueless and species-centric human being. Somehow the time I had with the mushrooms opened me up to the realization that I was not apart from the natural world, including all its inhabitants and our Mother Earth. I felt connected in ways I couldn't have predicted. Primarily, I learned that we are not the only species on this planet with rights. I did find higher doses to be more life changing and healing for psychological difficulties and for working out major problems. Higher doses provided more of a shift in my life view and habits.

Having imparted this personal experience, I want to emphasize that I neither encourage nor discourage the practice of consuming psilocybin mushrooms. I leave it up to you, with the expectation that you'll use the personal experiences, research, and stories I have brought together here as an aid for making the choice.

DENVER DECRIMINALIZES PSILOCYBIN MUSHROOMS

Denver recently became the first city in the United States to change the legal status of psilocybin possession. Initiated Ordinance 301, which passed in May 2019, does not make it legal to possess psilocybin mushrooms, but it does make the

adult possession and use of them the lowest law-enforcement priority in Denver, prohibiting the city from expending resources on enforcing related penalties. Recently, the city council of Oakland, California, as well as Santa Cruz also voted to make psilocybin mushrooms (and all entheogens — psychoactive substances), the lowest law-enforcement priority. In other words, they didn't decriminalize them, but simply placed them in the status that moves them toward recreational use. Unfortunately, according to federal law, psilocybin mushrooms are still listed as a Schedule 1 drug alongside heroin and cocaine.

ABOVE: I collected these specimens of *Psilocybe cyanescens* from a mixture of bark chips and grass in the Sierra Nevada foothills.

5

FUNGI IN THE WILD
AND
AT HOME

Walking through the forests and fields, looking for fungi during the fall and winter, I often encounter other hikers who stop to ask “what is that

mushroom?" Over the last 40 years of studying this fascinating, diverse group of organisms and learning from other "mushroom heads," I have come to learn more about where and how they grow, how to identify them, and in some cases, how to grow them. The ideas, techniques, and skills I share in this chapter come from my decades of study, hands-on experience, and from many others in the mushroom community.

UNDERSTANDING THE LIFE CYCLES OF FUNGI

The kingdom Fungi is a very large group that encompasses what we normally call mushrooms (macrofungi — those with large fruiting bodies), molds, water molds, and yeasts, among others. Unlike flowering plants, fungi disseminate themselves by spores that are so light and tough, they travel through the wind to far-off places, sometimes very high in the air. Researchers have found fungal spores in abundance in the troposphere (the lowest level of the atmostphere), and nearly half were still viable. [1]

After their release into the environment, the microscopic spores germinate when conditions are right. Usually that's when there's sufficient moisture in the presence of a chemical

activator from the environment — such as a concentration of carbon dioxide, chemicals like flavonoids, or abietic acid, which is secreted by trees and plants that form mutually beneficial relationships for exchanging nutrients. After germination, thin vegetative threads called hyphae emerge and start elongating at the tips and branching — forming the mycelium. The mycelium moves out into the environment, breaking down decaying leaves, twigs, branches, and entire trees. Mycelium also grows out into the soil, to connect with the roots of plants and trees.

Other chemicals produced by plant roots, as well as the presence of nutrients, further stimulate growth and branching of the mycelium, as well as reproduction. The hyphae avidly seek food and, at some point in their development, a genetically different type of mycelium of the same species to merge with.

Reproduction

The reproductive cycle of fungi is quite different from most plants and animals, partially because they can reproduce either sexually or asexually.

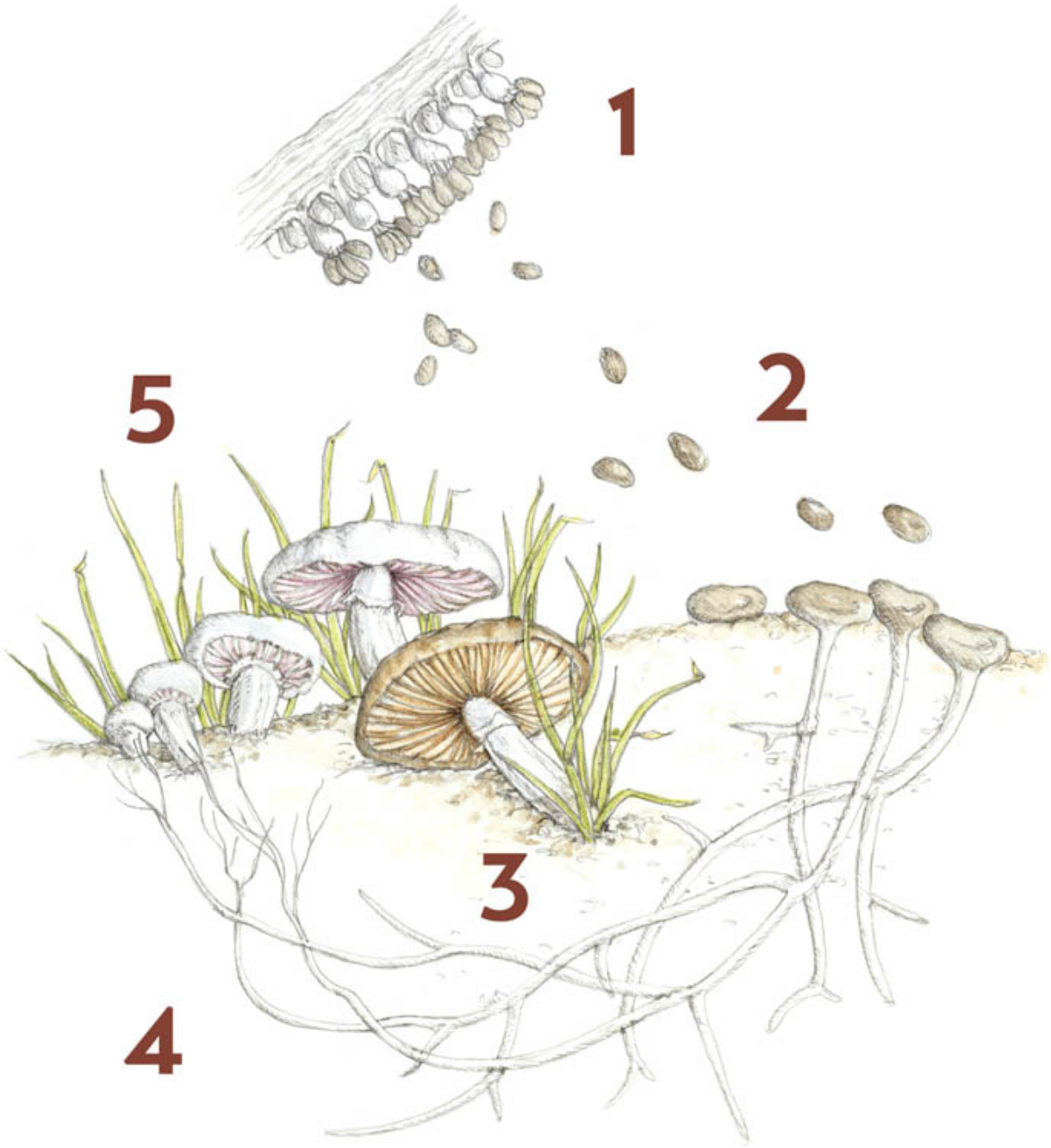
SEXUAL. Fungi do not have sexes in the same sense that animals do. Instead, different mushroom fruiting bodies of the same species have “mating types”: the genetically variant cells produced after spore germination. Spores and the mycelium that come from them have only half of the possible number of

chromosomes (which carry genes) for any given species. When two mating types merge — a process called karyogamy — the result is cells that contain two sets of genes from genetically different individuals of the same species.

However, although the cells and cytoplasm (cellular liquid) fuse, the nuclei stay separate, sometimes for years. When the time is right, the nuclei fuse, producing sporangia (structures that makes spores). This process greatly enhances genetic variation, increasing the potential for adaptation to changing environmental conditions and, ultimately, survival. For instance, when the local environment suddenly experiences an extended drought, genotypes with resistance to dry conditions can succeed and go on to reproduce, where the parent cannot.

After the nuclei fuse, the mycelium with two sets of chromosomes masses together to form a fruiting body (also called the sporocarp, or spore-producing body), during which spore-producing organs (the sporangia) are formed. In some fungi known as ascomycetes — such as morels — spores are produced in elongated sacs. When pressure builds up in the sacs, spores can be “shot” into the environment. In other fungi, called basidiomycetes, such as the common button mushroom, spores are produced on gills under the cap, on club-shaped organs called basidia. Other members of this group, such as the boletes and polypores, produce spores in open pores.

Life Cycles of Fungi



1. Enlarged gills with basidia (club-shaped structures that produce spores)

2. Spore germination
3. Merging hyphae from two different spores (which increases genetic diversity)
4. Hyphae continue to grow and seek food. When conditions are right, the mycelium masses together to form a new fruiting body.
5. Sporocarps (fruiting bodies)

ASEXUAL. Some fungi also reproduce asexually, via two methods. One of them, called budding, occurs when the cell forms an outgrowth containing some of the cell contents and DNA from the nucleus, which is then shed into the environment. Another method is fragmentation, in which fragments of mycelium break off and start new colonies. Asexual reproduction does not lead to as much genetic diversity as sexual reproduction, but it is more energy efficient and is convenient for starting new colonies when the mycelium grows into a place where conditions are favorable to produce another colony as its parent moves on to find other resource-rich environments.

HOW FUNGI ACQUIRE NUTRIENTS

Like all living things, fungi must acquire nutrients to grow and thrive. All fungi are heterotrophs, meaning they obtain their food from dead and decaying plant material or from living trees. (This is compared to plants, which are autotrophs: They make their own energy from photosynthesis, which requires sunlight, carbon dioxide, and water.) To accomplish this, fungi have developed cell walls composed of flexible yet tough interconnected polymers like chitin, beta-glucans, and proteins. This enables them to penetrate wood and soil with their mycelial threads, probing and secreting powerful enzymes once they identify material they want to consume. Most fungal species are saprophytic, mycorrhizal, parasitic, or endophytic.

ABOVE: *Agaricus subrufescens* Saprophytic fungus

Saprophytic

Saprophytic fungi live on decayed organic matter, especially if it is rich in starch and sugar. Molds and yeasts are saprophytic. Think of mold growing on strawberry jam or bread, and yeasts fermenting sweet apple juice to vinegar. Fungi from the genus *Agaricus*, which include the common button mushroom *A. bisporus* and related species, as well as members of many other

fungal groups, are saprophytic. In meadows, these species tend to live on decaying grasses; in the forest, they survive on decaying leaf litter and duff, as well as twigs, decaying branches, and tree bark. Without fungi to recycle dead and weak biomass, the world would be a very different place where trees would be stacked up to the sky.

Mycorrhizal

Mycorrhizal fungi are those that form intimate relationships with both herbaceous plants and trees: *myco* = fungi and *rhizal* = root. These associations benefit both the fungi and the plants. The plants take advantage of what the fungi can extract from soil and decaying matter, such as nitrogen and minerals. Mycorrizhal fungi also assist plants with water uptake, and can synthesize chemicals to prevent bacteria and other potential pathogens from invading tree roots for the sugars. In return, the fungi gain what is crucial to all life: energy in the form of sugars (which plants create abundantly via photosynthesis). The mycorrhizal association between fungi and plants is almost universal, and has been perfecting itself though countless millions of years. Mycorrhizal species you might be familiar with include *Amanita muscaria* (fly agaric), *Boletus edulis* (porcini), all the *Lactarius* (milky caps), and *Cantharellus* (chanterelles).

Mycorrhizas can either be "balanced," meaning both the plant and the fungi receive substantial benefits, or

“exploitative,” meaning that the fungi or plant receives greater benefits than the other partner. [2]

ABOVE: *Cantharellus* species Mycorrhizal fungus

Parasitic

Parasitic fungi will attack live organisms such as insects and trees. Fungi from the genus *Cordyceps* attack and consume a variety of insects including moth caterpillars, cicadas, ants, and many more. Cordyceps is famous as a medicinal fungi from traditional Chinese medicine and now throughout the world as a tonic that is traditionally held to give the user more

energy, vitality, and even long life. We discuss cordyceps in much more detail in its own section.

Some groups of fungi will attack live trees and kill them. Fruit farmers fear the honey mushroom (*Armillaria mellea*) because of its potential to attack fruit trees.

ABOVE: *Cordyceps tenuipes* Parasitic fungus

Endophytic

Endophytic fungi live within the plant leaf tissue but do not cause harm to their host. An estimated one million species of endophytes live in plants. [3] These are essentially asymptomatic infections by the fungi within the plant tissues. Endophytes are the source of many biologically active compounds the plant can use to defend itself and adapt to changing environmental conditions. [4] The endophytes also benefit. They have a safe place to live (inside the plant) with a plentiful supply of sugar and other nutrients. It's a match made in nature that benefits both organisms. [5]

Endophytes are known to inhabit conifer needles, bark, ferns, mosses, and most other types of plants. The most famous example is the anticancer drug paclitaxel (Taxol) derived from the bark of the Pacific yew tree. Initially, the bark and needles of this slow-growing yew were "mined" extensively for the cytotoxic compound, potentially harming the health of ancient forests. Once researchers discovered that it was really a fungus that produced most of the paclitaxel and not the trees, the valuable compound could be produced by culturing species of fungi. So far, many kinds of active compounds have been isolated from plant endophytes, including alkaloids, steroids, terpenoids, peptides, polyketones, flavonoids, quinols, and phenols as well as chlorinated compounds. [6]

YOU ARE PART FUNGUS

Humans and other animals, as well as plants, depend on their endophytes to maintain health. When our body's microflora is in a good balance for health, we benefit because more pathogenic types of bacteria are suppressed by our immune response, and even by substances produced by our beneficial microflora. The really wild part about endophytes living in association with human and plant cells and tissues is that the microbes are swapping DNA with their hosts, in some cases providing useful genetic material that can lead to increased "fitness," or the ability to adapt, reproduce, and survive. 7

FORAGING FOR MUSHROOMS

Getting out in the woods in wild areas in fall and winter and wandering through the evergreen shrubs of huckleberry and manzanita and under conifers or hardwoods (depending on what part of the country you live in) has its own special healing magic. The smells of the earth and the growing fungi often have a delightful, sweet fragrance to lead you on and on, along creeks and through clearings replete with decaying leaves (the duff) that might be a foot thick or more. These are often places where some of the best fungi fruiting bodies grow, pushing up

to the light, forming “mushrumps” — emerging mushrooms pushing up the duff or pine needles but not yet visible. It’s so exciting to discover a delicious edible or medicinal mushroom as you uncover the heap of duff to see the cap peeking up underneath.

Observing and Identifying

Among the wild fungi that produce fruiting bodies are many used for food and medicine. Some of these are fleshy and soft, others are about as hard as wood (conks); the latter often grow and fruit on wood, either dead or living trees, and sometimes shrubs. Many polypores such as reishi-like mushrooms and turkey tails grow on fallen logs in the woods or along creeks. When you spot a place with a number of downed trees, look along both sides and underneath; you’ll likely see fungal mushrooms coming out from the decaying bark, sometimes in great colonies. This is especially true in the wet months of the year. I often find many fruiting bodies along creek bottoms where trees lie across the creek. The moist and cool environment encourages the growth of oyster mushrooms, turkey tails, red-belted polypores, artist’s conks, and others.

Mushrooms come in a dazzlingly diverse range of colors, shapes, and sizes. When you are learning to recognize fungi in the field, look at as many different ones as possible. Study the underside of the cap, observe if it has pores or gills, feel it to determine how tough and hard it is, and closely observe if it is growing in the ground or directly on wood. Be careful here, because sometimes the mushroom is growing on wood that is

submerged underground. Keep a notebook where you can make notes about the basics for identification purposes.

ABOVE: Even when there is a bounty, as with these honey mushrooms, responsible harvesters will leave enough behind to drop spores and regenerate the colony.

LEARNING TO IDENTIFY MUSHROOMS

Identifying mushrooms can be difficult at first, but it becomes easier as you practice, especially if you take the time to carefully observe, take notes, and consult reliable field guides (see Recommended Reading). Attending mushroom talks and

going on walks with experienced mushroom foragers are especially valuable; there's no substitute for seeing a mushroom in the flesh and having a knowledgeable person point out its identifying characteristics.

Identifying Characteristics

After more than 40 years of avidly seeking mushrooms, I've learned that there are key characteristics to observe and consider when you're foraging. For a confident identification, it's best to match up three to five characteristics that are specific to the genus and species. Following is a list of the most important traits to observe and take note of, arranged by importance (though they are all important). This is obviously not a comprehensive dive into mushroom identification, which requires much more space than we have in this book, but my recommendations for guides that will help you key out mushrooms to genus and species are in the Recommended Reading.

FRUITING BODY SIZE. Mushroom sizes range broadly, from minute (1 inch high) to small or medium (2 to 3 inches high) with cap sizes from 1 inch up to 6 or 8 or even 12 inches across when fully mature and expanded. One humongous fruiting body found under a decaying tree in China was 33 feet across and estimated to weigh around a thousand pounds!

FRUITING BODY SHAPE. The cap and stem come in all shapes — vase-shaped, bell-shaped, cone-shaped, dome-shaped, and so on. Some fruiting bodies have stems of various lengths and thicknesses, others have no stalks or very short stalks found on a lateral edge rather than in the center of the cap. Oyster mushrooms and many polypore fungi have these types. Some can be irregular; some are very regular.

FRUITING BODY COLOR. Brown is the most common mushroom color, but you can find mushrooms in almost every color of the rainbow. For instance, mushrooms from the genus *Russula*, which frequently grow in woods, can be forest green, purple with yellow highlights, vivid red, white, cream-colored or yellow, or almost black. Many members of the genus *Agaricus* are white, cream, or tan on top (like the button mushroom) with some markings of brown or red. The cap and stalk can "stain" red, yellow, or blue, or darken when bruised, such as the milky caps from the genus *Lactarius*; white or colored milk can exude when cut.

GILLS, PORES, TUBES, OR TEETH. Mushrooms often have gills, pores, longer pores that form tubes (found in the boletes and close relatives), or teeth (like members of the genus *Hydnum,* such as the hedgehog fungi, *H. repandum*). Some fungi fruiting bodies appear to have no pores or gills. The pores on the bottom of the so-called false turkey tail (*Stereum* species) are so minute they cannot be seen without a microscope.

GILL ATTACHMENT TO STEM. In some species, the gills are not attached at all to the stem, or they can be attached in various

ways. At the point of attachment, they can be notched, come into the stem perpendicular to the stem, or run down the stem (decurrent).

GILL COLOR AND SPORE COLOR. Gills and spores can be white, cream, shades of brown, rusty brown, yellow, pink, red, black, or purple. Be sure to make a spore print, as this is one of the most important characteristics, and the colors are mostly easily differentiated. Sometimes field guides will give a range of brown colors because these are so common, such as red-brown, purple-brown, to rusty brown.

GILL EDGE, SPACING, AND LENGTH. The fruiting body might have gills of varying lengths. They might be tightly packed or loosely spaced, and the edge may be uneven or very even.

ABOVE: Clockwise from top left: *Suillus* species, *Coprinus comatus, Amanita banningiana,* and *Russula sanguinea*

Just a few of the many traits that will help correctly identify a species include: whether it has pores or gills, the texture and color of the cap and stem, and whether it emerges from an enveloping sac called a volva.

Make sure of your identification before using any mushrooms for food or medicine. Make your ID on as many traits as you can — preferably four or more.

CAP TRAITS. The cap (also called the pileus) may be small or large, rough or warted. Feel the cap to determine if it's sticky, slimy, or dry to the touch. Some feel dry but become very sticky, even glutinous, when wet. You can check this by putting a little water on the cap and rubbing it.

>

STEM TRAITS. The stem (also known as the stipe) can be thin or thick, tough or fragile. It may be off-center or even absent. The stem can break cleanly like a piece of chalk (characteristic of the russulas and milky caps), or it can shatter unevenly. It can be hollow or solid. If a ring is present, it most likely occurs at the top of the stem. Stems can be adorned with cobwebby tissue (as found in *Cortinarius* species), netting (as found in *Boletus* species), or resin dots (as found in *Suillus* species).

ABOVE: Whether or not gills are attached to the stem (as shown here) can be an indicator of species.

STEM BASE. The bottom of the stem may have an enveloping cup or volva of various kinds (an important characteristic of the genus *Amanita*, which contains a few lethal species). Once cut or pinched, it might turn yellow, blue, or red, or oxidize to brown or blue when bruised or handled. Members of the genus *Psilocybe* may be noticeably blue at the base.

SCENT. Scent is an important identifying trait. I once met a mycologist in Europe who said he could identify any mushroom solely by smell! Although some species just have a mild or sweet "mushroomy" aroma, some smell like radishes,

green corn, sweet almonds, or anise. Some smell like rotting meat, which attracts flies to disseminate the spores, or have an industrial chemical odor (avoid eating the latter). Don't sniff close to the gills, because you might inhale spores, which can lead to an allergic reaction. Cut or bruise the stem bottom or the top edge of the cap, then sniff.

FLAVOR. A mushroom's taste can be an indicator of its edibility. Bland, mild, or sweet-tasting mushrooms are more likely to be edible (but don't count on this alone; the deadly Amanita species are reported to be delicious!). Mushrooms can be acrid like horseradish (such as some species from the genera *Lactarius* or *Russula*), bitter, or even chemical tasting, and these are a lot less likely to be edible. To taste-test a mushroom, I put a small piece of the edge of the cap and/or stem in my mouth, then I smack on it a bit to get the taste — sweet, bitter, acrid, chemical, or bland. After tasting, don't swallow; just spit it out. Rinse out your mouth and spit that out if the mushroom tastes unpleasant. Even a very toxic mushroom is unlikely to make you sick under these circumstances, but if you suspect that you're evaluating what might be a highly toxic or lethal species, such as *Amanita phalloides*, I'd advise simply smelling the mushroom rather than tasting it.

SUBSTRATE. What a mushroom is growing on — the substrate — may help you identify the type of mushroom it is. Carefully notice if it's growing directly in the soil, on wood (or submerged wood that makes it seem like the mushroom is growing on the soil), or among decaying leaves or grass, as well

as what types of trees are nearby or what species of tree they are growing on directly.

TAKING A SPORE PRINT

When you're trying to identify a mushroom, determining the spore color will often get you in the right ballpark, as well as help differentiate between two similar-looking specimens. For example, the nauseating green-spored mushroom (*Chlorophyllum molybdites*) found in lawns is very similar in appearance to two favorite edibles, *C. brunneum* and *C. rhacodes* (both known as "shaggy parasol"). One key way to tell them apart is that the edible species have white spores.

If you're in the field, you can find the spore color by pulling back one fruiting body that overlaps another and looking for any deposited spores. This is a great way to help identify the honey mushroom (*Armillaria mellea*), which often grows in dense clusters and has a white spore print that clearly shows up on the brown caps underneath another. If the mushroom is a single specimen or one without overlapping caps, you can easily determine the spore color by taking it home and making a spore print. Simply cut off the stem, place the cap on a piece of paper, and cover it to keep the spores from blowing away. Wait a few hours for the spores to drop (overnight might be required in some cases), then check the color. Spores can be white, pink, flesh-colored, yellow, buff, many shades of

brown — like rusty brown or chocolate brown — purple, and black. Compare the spore color with those of other mushrooms in a field guide, and key out as many other features as possible to make a positive identification.

AVOIDING TOXIC SPECIES

Of all the wild fungi species that are large and meaty enough to bother with, only a few are lethal, but quite a few more can cause nausea and vomiting. A handful can even alter your consciousness or induce colorful visions (we explored those in chapter 4). In past times, humans had to learn the hard way

which mushrooms were toxic and which were edible or medicinal. Rather than learn by trial and error, you can simply learn to identify and avoid toxic species by using field guides or attending mushroom walks or classes led by knowledgeable instructors.

The Lethal Eight

The following genera contain fungi that are known to be lethal; I recommend learning their specific characteristics *before* picking and using any wild mushrooms. In fact, avoid any species in these genera until you feel comfortable with your knowledge gained from fieldwork and expert guidance. Again, this is just an overview of which species to avoid; be sure to consult a reliable field guide when attempting to identify any mushroom. Refer to Recommended Reading for books that discuss mushroom toxicity in detail.

Amanita species

The genus *Amanita* contains some of the most widely known and encountered potentially lethal mushrooms — especially *A. phalloides* (the death cap), *A. bisporigera* (the destroying angel), and a few others. Although a handful of species from the genus *Amanita* are actually edible (and the hallucinogenic fly agaric is not deadly; see Legendary Amanita muscaria), it's best to avoid all of them until you have become expert in

identifying members of the genus. We have a saying: “Don’t-a eat an amanita!”

Amanita’s spore print and gills are white; the caps are medium to large when fully open and mature. A felty ring often but not always occurs on the upper part of the stem. A cup is present at the bottom of the stem; sometimes the cup is free at the top, forming a clear cup. Sometimes it adheres to the bottom of the stem, which is often bulbous. The gills turn up toward the center and do not directly connect to the stem, which can be clearly seen when the cap and stem is cut in half. The fruiting bodies grow on soil or on forest litter, but they form mycorrhizal relationships with nearby conifers and hardwoods. The cap is variously colored — depending on the species, it may be white, orange, brown, bright red, or yellow; yellow-green amanitas growing under oaks in fall and early winter should especially be avoided.

Amanitas often have white or yellow felty dots covering the top of the cap, or the top of the cap will just have a patch of white tissue in the middle. Some species have neither a volval patch nor dots, but if they are present, it is likely from the genus *Amanita.*

Gyromitra species

Also known as false morels, these medium to large mushrooms are highly contorted, saddle-shaped, and usually brown, and have an infamous reputation as lethal mushrooms. The stalk can be ribbed or fluted and may be chambered when cut in half. They can be found growing out of the soil or on rotting

wood. Their toxin is monomethylhydrazine, a potent carcinogen.

ABOVE: *Clockwise: Amanita phalloides, Gyromitra caroliniana, Galerina marginata, Amanita bisporigera*

Galerina species

These are often small, scattered to clustered, yellow or orange-brown to brown mushrooms with brown spores. Some have a tiny felty ring on the upper fragile stem (though this can quickly degrade). Several species of *Galerina* contain amanita toxins — the same potentially lethal peptides found in the death cap, *Amanita phalloides*. Some grow on wood, some in grassy areas. They all have spores that are some shade of brown. My advice is to avoid all brown-spored mushrooms that are too small to be of culinary interest.

Note that the taxonomy of *Galerina* has not been completely worked out, so other closely related genera such as *Tubaria* and *Pholiotina* (*P. rugosa* is also thought to be deadly) are often placed in a larger, shifting, and confusing group that includes *Galerina.*

ACCIDENTAL AMANITA POISONING

The death cap (*Amanita phalloides*) is one of the best-known causes of mushroom poisoning in many countries. One reason for this is the occurrence of massive fruitings of the mushroom in some years. The fruiting bodies themselves are large and noticeable and have a similar appearance to fungi picked commonly as an edible in Asia, such as the paddy straw mushroom (*Vovariella volvacea*). Unfortunately more than once, I've read news stories from the Bay Area about families from Southeast Asia who

make this mistake and cook up a batch of death caps for the whole family, often with disastrous results.

Over 2,000 cases of amanita poisoning have been reported worldwide in the the last 25 years but this is likely underestimated. Poisonings are much more common in Europe than the United States because mushroom hunting is more a part of the culture, and so many more people eat wild mushrooms.

The toxins death caps contain are found in other species of *Amanita* (though only 9 out of 600 species in the genus) and unrelated genera. They are small cyclic proteins (peptides) known as amatoxins, phallotoxins, and virotoxins that are not destroyed by cooking. They are highly destructive to the liver if enough of them are consumed. About ½ cup or 1 ounce of the fresh fungus is estimated to be enough to kill a human.

After eating mushrooms containing these toxins, the victim may experience a 6-hour delay before experiencing any symptoms. If left untreated, the symptoms progress through three phases: 1) digestive upset, nausea, and diarrhea (6 to 24 hours after eating); 2) a false recovery stage, in which the victim feels better and seems to recover (24 to 72 hours); and 3) increasing symptoms related to kidney and liver failure, such as nausea, vomiting, diarrhea, headaches, dark urine, and pain under the right rib cage where the liver is located (4 to 9 days).

Fortunately, procedures exist to counteract the toxins in the death cap, and most people recover, especially if counter-measures are started within 36 hours of ingestion. Gastric lavage (removing contents of the stomach) is only useful within an hour or so after ingestion. Activated charcoal, to absorb as much of the toxin as possible, works well if started within an hour or two after eating the mushrooms. Some treatments like intravenous saline, silymarin from milk thistle seeds, and antioxidants are often administered, but treatments vary

in clinics around the world, and also depend on the specific conditions for individual patients. [8]

Paxillus species

This genus of yellow-brown spored species with gills that go down the stem should be avoided. The fungus *Paxillus cuprinus* (poison pax, formerly referred to as *P. involutus*), a yellowish brown medium-size mushroom, has been associated with deaths due to kidney failure, sometimes made worse when eaten without thorough cooking. People can also have a dangerous immune reaction to a glycoprotein in the mushroom. This species is characterized by a cap margin that strongly rolls under (in-rolled), a cap that is viscid or sticky-slimy when wet, and flesh that often stains red to brown when cut. The poison pax is common and grows in abundance some years, other years scattered, sometimes around parks and lawns, especially when trees are around.

ABOVE: *Paxillus involutus*

ABOVE: *Paxillus* species look-alike *Tapinella atrotomentosa* should also be avoided.

Cortinarius species

Cortinarius is the largest genus of gilled mushrooms on the planet, with over a thousand species described. This is a common, widespread group of fungi, some of which are toxic. *Cortinarius orellanus* (fools webcap) is a European species, reported to cause renal toxicity and sometimes death due to kidney failure. The kidney toxin is known as orellanine and is also found in *C. rubellus* (which may also be called *C. ranierensis* or *C. orellanoides* and is reported from sphagnum bogs in eastern and western North America), and *C.*

orellanosus (reported from the Upper Midwest and other parts of northern North America).

These are mycorrhizal mushrooms that grow on soil under mixed deciduous and coniferous trees (and sometimes in pure deciduous forests). Their most characteristic identifying features include the presence of a cobwebby partial veil and a rusty brown to ochre spore print. The gills are attached directly to the stem. When fruiting bodies are very young, the veil can cover the gills completely; it tears away as the cap expands and hangs from the margin of the cap or in pieces on the stem. These pieces often have rusty brown spores clinging to them, helping to confirm the identity of the mushroom. Eventually, the veil remnants may disappear. Some members of the genus may have an expanded and bulbous stalk base. The cap and stem color can differ from purple to white, yellow, to orange and red.

ABOVE: *Cortinarius gentilis*

Clitocybe and *Inocybe* species

These are two common genera to leave alone when collecting mushrooms for food or medicine. *Clitocybe* species are small to medium mushrooms that have cream, buff, light brown, or even lilac spore prints, and commonly feed on decomposing forest litter. *Inocybe* comprises more than 1,400 species. Like *Clitocybe* species, these also have small- to medium-size fruiting bodies, with fibrous caps; many have an "umbo," or raised bump, in the center of the cap. The cap color is white to tan, buff, brown, or lilac or even lavender, and sometimes with striations (lines) around the sides of the cap. They typically have brown spore prints and some species smell like green corn, or smell fruity or musty. They are mycorrhizal and are found in forest duff.

Some members of these genera contain toxic levels of muscarine (up to about 1.5 percent), causing a variety of unpleasant symptoms, such as nausea, vomiting, lung spasms, and intestinal cramps. Two common species containing potentially toxic levels of muscarine are *C. rivulosa* and *C. dilitata*.

ABOVE: *Clitocybe* species

ABOVE: *Inocybe maculata*

Conocybe species

Conocybe and the small genus *Pholiotina* (now separated from it based on DNA analysis) are often brown-spored decomposers on grass, dung, moss, or humus. They are mostly small and fragile, conical, or bell-shaped. The spore print is typically reddish-brown to cinnamon-brown. A well-known species in the group now called *P. rugosa* (formerly *C. filaris*) grows commonly in lawns and contains the same toxin as the deadly amanitas.

IS ANY GENUS TOTALLY SAFE?

Can a genus be considered simply toxic or edible? Unfortunately, it's not always that straightforward. Most mushroom genera — even those containing well-known toxic species such as *Amanita* — include some species that are edible. If you're just becoming familiar with foraging mushrooms, however, it's best to start with species in the "safe" category, and avoid collecting from any genus that contains toxic species.

The safest genera to start with include *Cantharellus* (chanterelles and allies like the black trumpet), medicinal polypores (such as reishi-like mushrooms or turkey tail), *Pleurotus* (oyster mushrooms), and *Tremella* (jelly mushrooms). No mushroom is absolutely foolproof, though.

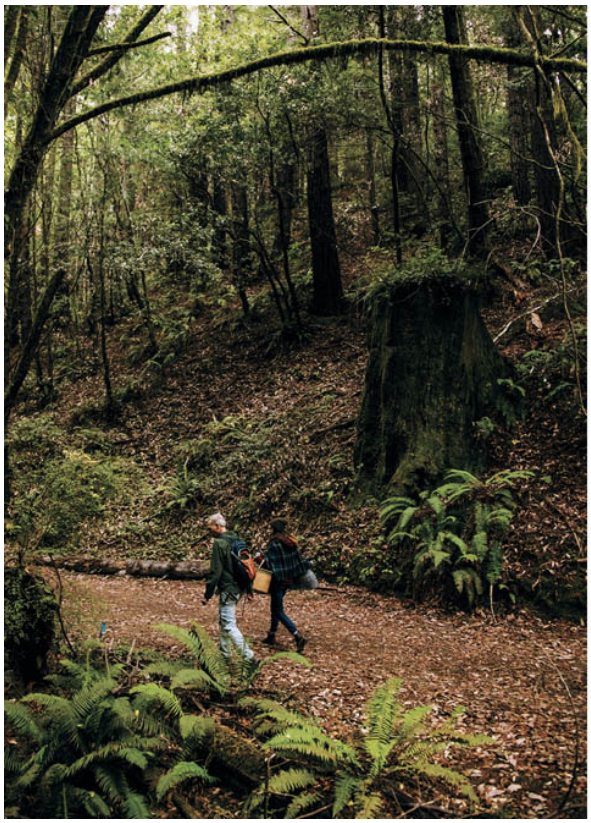
As always, be sure of your identificatioin before eating and start out trying just a tablespoon the first time.

It's important to emphasize again that some people can react with nausea and digestive upset *even with edible species*, especially if the mushrooms are not well cooked, if multiple species are eaten at one sitting, or if the portion in the meal is too large for a given individual's digestive system to deal with. This effect might be caused simply from all the chitin and other indigestible fiber, and not from any toxic compound. In these cases, I recommend drinking ginger tea, with or without a shot of herbal bitters (with the herb gentian), which will often ease the symptoms rapidly. However, if symptoms worsen and/or you have any reason to suspect that you've eaten something toxic, seek immediate medical attention.

ABOVE: *Clitocybe dilitata*

YOUR FORAGING ADVENTURES AWAIT

Mushroom hunting must be ancient, since such rich and tasty food probably wasn't easy for a hungry Paleolithic person to find. In wetter climates of past times, fungi should have been plentiful. By trial and error, humans learned the edibles and rejected the rest (though, clearly, we still make mistakes). In areas of the world with abundant rains and forests, such as Siberia, Africa, parts of China, Europe, and North America, mushroom foraging became a tribal and then a family necessity. Perhaps an instinctual drive for the hunt added to the pleasure of wandering through the woods with the hope of finding some of the most delectable species like porcinis, chanterelles, oyster mushrooms, or morels. Today people from many cultures go forth to hunt their favorite fungi, carrying a brush and sharp knife to cut and clean them, and baskets to carry them home.



Often, the pleasure of going on a foray through the misty forest — with deep pine needles or layers of decomposing leaves underfoot, the air redolent of pine, fir, or spruce — is at least half of the benefit. Although I love finding my favorite edibles, I'm happy even if I get "skunked" and find none. I feel better after wandering through the forest than when I came. Intuitively, I feel the connections with the many species around me, and I celebrate and feel deep gratitude after acknowledging and reconnecting with the creatures nearby and for remembering I'm part of the amazing intelligence of the natural world. This is where I am happiest and the most at peace.

Mushroom hunting keeps me on my toes and is great for attuning me to my environment, natural cycles, and the

seasons. Over the years, mushrooms and mushroom hunting in fields and forests have helped me feel at home on planet Earth, part of the web of life, and fully involved with all the cycles and changes that are always to be expected and accepted.

Start with Unmistakable Species

After you've learned which species not to pick, get to know two or three species that, with proper identification, would be difficult to mistake for a toxic species, such as chanterelles, porcini, turkey tails, and reishi-like mushrooms. If you're looking for a particularly medicinal species, you can't go wrong starting with turkey tails, which are described in the profile. They are widely found in many parts of the world, likely in some woods near you. Look for them in summer, fall, or winter. Its main look-alike is the false turkey tail (*Stereum* species) which often grows on the same log or nearby. However, it is not toxic and does contain beta-glucans; it simply doesn't have the long history of traditional use that turkey tail does, and it is not as substantial, fragrant, or flavorful.

Take Notes and Start a Mushroom Calendar

It took me years to get into the habit of keeping a mushroom calendar, to track when different species come up, where, and in what kind of habitat. Now that I've kept a calendar for a number of years, I know the approximate time to check my patches and thus miss fewer of the delectable edibles and medicinals. You might even want to note the longitude and latitude, which is easy to do with the advent of smartphones; simply mark and label the exact spot in a mapping app. I carry

a phone to get the exact coordinates, but I also store a small calendar book in my pack to record the dates I find the most notable species.

Fruiting times at a favorite mushroom site will change from year to year, but after a few annual cycles of watching rainfall patterns and temperature changes, your intuition will develop. Warm, wet weather can stimulate fruitings of some mushrooms; others prefer cold (but not freezing), wet weather. Although many polypores can still be harvested in or after freezing temperatures, many fleshy fungi like porcinis will quickly become mushy and unusable.

Watch for Rainfall

One universal truth is that mushrooms like rain. The trick is to become familiar with how much rain has previously occurred to get the mycelium growing, and perhaps more rain later to stimulate fruiting. Too much rain can lead to soggy mushrooms even in their early development and growth. A big rain and then a week or two of rather dry weather or light rain can be ideal, depending on the time of the year. Learning the cycles of rain, dry spells, cool and warm temperatures, compared with when fruitings are to be expected, may take a number of years in one area. Peak fruitings of a choice species can occur in a window of as much as four or five weeks; typically, though, it's within a week or two if conditions are more or less normal.

I have a saying that usually helps me to feel positive and open-minded and curious when looking for mushrooms:

“Mushrooms are where you find them.” They can pop up in your “spot” for a few years, then not at all for a year or two. They may stop fruiting altogether in that location and appear somewhere else.

Mushrooms are where you find them.

Take Note of Nearby Species

When collecting, it pays to take notes on which plants, trees, and other mushrooms are growing around the species of interest. For instance, I find that when the fly agarics (*Amanita muscaria*) are fruiting, some exciting porcini (*Boletus edulis*) may also be fruiting — perhaps under a nearby pine or oak tree.

When you hunt enough, you begin to get a sense of a place and associate that with certain desirable species. When I'm searching for polypore mushrooms for medicine, I look for stacks of wet logs or downed trees — especially big, old ones by creeks. I look along them for the brackets, even out of sight under the log or on the other side. After a while, you get a sense of where fungi are most likely to be and when — how wet it has to be, what month, and how much rain has already come.

AFTER THE DROUGHT

Droughts can be miserable for an avid mushroom hunter; a long dry spell can mean no mushrooms, or very few, for up to several years. I've watched this happen a number of times. At first, when a lot of rain would come after two to four years of dry weather, I expected (or fantasized, anyway) to see a giant flush of delicious fungi popping up

everywhere, even in my backyard. After a few cycles, I learned that it wasn't always so. Then I realized why.

Since so many mushrooms, especially in the forest, are exchanging nutrients and sugars with trees, it takes a year for trees to recover after a dry spell and to start producing more sugar they can share with the mycorrhizal partners in the soil in and around their roots. What I've observed is that often the big fruiting comes the second year of good rains after a drought. At this point, the mushrooms have the sugars they need, in the form of the glucose polymer glycogen, to produce abundant fruiting bodies. Besides, perhaps they "know" that during these cycles of rain and dry, several years of rain mean that more rain is to be expected in a wet year and so when the spores are released, they can wash far and wide to produce more colonies. I have often had the feeling that the wild fungi are so connected to the natural cycles of the forest and meadows that the presence of fruiting bodies bodes well for further rainy weather, but this hasn't always been true.

HARVESTING, PROCESSING, AND STORAGE

When harvesting mushrooms, consider your potential ecological impacts before anything else. Watch where you step to avoid treading on delicate plants or small fungi fruiting

bodies. Don't take more fruiting bodies than you can realistically use. And harvest individual mushrooms carefully.

Collect Selectively

When you find fruiting bodies, try not to take more than half of what is there, especially if they are not abundant. If there are a lot, it's easy to be greedy and collect more than you can clean and realistically use. I've had to rein myself in many a time when faced with big fruitings of porcini or chanterelles. Stop and think through how many you can give away and how many you want to eat, or if you are really going to dry them for later use.

Pick the small and medium ones; always leave the biggest to produce spores. The smaller fruiting bodies are often firmer and better tasting, anyway. And the larger mushrooms may be produced by the "grandmothers" or "grandfathers" of the genetic strains from the local population. In some cases, the bigger specimens may simply be the most mature, but for some polypores, especially perennial conks, if the fruiting body is old, that means that genetic strain may have better survival traits.

If you're not sure of your species identification in the field, don't collect a lot the first time. They may all go to waste if you find they are not the species you were looking for. Bring home one small one and one medium one, take a spore print, and use a reliable identification guide to try and identify it. Take pictures and notes.

I tend to collect specimens that are firm, not too mature, and not wormy, discolored, or moldy. I also collect buttons (unexpanded caps) that are firm yet more developed than tiny ones, or in the case of chanterelles, any size mushrooms that are firm and not discolored.

Often the big fruiting comes the second year of good rains after a drought.

Leave the Mycelium

Some research suggests that pulling the fruiting bodies up will not harm the mycelium too much. However, it makes sense that pulling them up can dry out the mycelium below, for species that have masses of mycelium adhering to the the bottom of the stipe. I usually prefer cutting as close to the ground as possible, unless I need the intact base for identification purposes. If you do pull up a mushroom, fill the hole with dirt or duff; I've always thought this was a courteous gesture to other collectors. Nothing is more depressing than seeing a lot of holes with a few fragments of an edible bolete in them.

When selecting the best specimens for the table on the spot, make sure they are not completely wormy inside by slicing a large fruiting body in half, top to bottom, and looking it over. I

have seen firm porcini buttons that look delectable but when sliced in half were a mass of writhing mushroom fly maggots — not very appetizing. This is a cosmic mushroom joke for a porcini lover. I've learned to not get too excited after finding a patch of porcinis until checking them. Bigger and older porcini are even more likely to become wormy and completely degraded inside. Fortunately, chanterelles are amazingly resistant to molds and fly larvae and are often perfect.

Take the Right Tools

When you go on a mushroom-hunting foray, take with you a woven basket with a handle. If you don't have a basket, a cloth bag (perhaps lined with wax paper) will work for firm mushrooms that aren't easily crushed. Wax paper sandwich bags are useful for protecting prized perfect fruiting bodies. Stuffing a variety of soft, soggy mushrooms into a single bag is a sure way to get home and find a big mushy mess, or many pieces of broken mushrooms, making identification difficult.

I use a mushroom knife with a short, curved blade on one side and a brush on the other. The knife is for trimming any dirty or degraded parts of the mushroom, and the brush removes dirt and duff before the mushrooms go in my basket. Storing mushrooms with a lot of dirt and debris on them will result in a mess when the dirt gets on the sometimes wet or sticky caps of clean mushrooms. Some hunters put a long cord on the knife, making it easier to fish out of the pocket when frequently finding fantastic fungi.

You can use rather stiff plastic bags with handles to transport mushrooms home, but take the fungi out as soon as possible; they start degrading and breaking down rapidly when moisture accumulates, especially in a warm car or house. Cloth shopping bags are good but have to be dedicated for that purpose because they will become stained and dirty in no time at all. You can also use fishing tackle boxes with a number of small compartments to collect very small, delicate specimens for identification. When in the field, you can identify fungal fanatics when they pull out the tackle box with a few tiny specimens!

Postharvest

When you get home, rinse mushrooms with a fairly forceful stream of water; rub off residual dirt, duff, or pine needles; then pat dry with paper towels or a soft cloth and place the mushrooms on a cloth or paper towel to dry. Clean off any remaining dirt and duff at the base of the stem by trimming with a knife.

Short-Term Storage

After they've been cleaned of debris and trimmed, mushrooms can be stored in the refrigerator for several days to a week in wax paper sandwich bags, folded over to keep the mushrooms from drying out. A little air should be able to enter so the bag doesn't get humid inside and encourage bacterial growth. Edible mushrooms can be temporarily stored in a glass storage container in the refrigerator. Some species will be fine in the fridge for up to a week, some only a few days, and some even less. Don't leave them out on the counter when it's warm outside; they can rot quickly. Slice edible species and cook them — but only after smelling them and looking them over for mold or signs of decay.

Long-Term Storage

Drying mushrooms in a food dehydrator is a great way to preserve them for long-term storage. Sliced and dried

mushrooms can hold their taste and usefulness for several years, if properly stored in airtight jars out of the heat and light.

Some mushrooms should be frozen for up to three days, to kill mushroom fly eggs and larva. This includes turkey tails, reishi, and other species. Thick, heavy, dense polypores like artist's conk, red-belted polypores, or species of *Phellinus* or *Fomes* don't need much treatment. It's best to cut them into slices while they're still fresh because they become tough when dry, requiring a saw to cut them. The slices can be laid out in a warm, dry place with good airflow, or placed in a food dehydrator. After the mushrooms are fully dry, store them in airtight jars away from heat and light, and label the jar with the species and collection date.

FORAGE WITH THE FAMILY

In places like the United States and the United Kingdom, where there are many fungiphobes, we are just starting our love affair with mushrooms. In other cultures around the world Asia, Russia, and eastern Europe, in particular — many people are crazy about fungi. Hunting for mushrooms is a time-honored way of connecting with family, friends, and the land. Going on a treasure hunt in nature is an activity in which children especially take delight.

Kids naturally take to a hunt, and the bright colors of mushrooms lead them on and excite them. I began taking my son, Ken, out in the woods when he first learned to walk.

I'm sure he picked up on my expressions of joy and excitement when seeing a few chanterelles or porcinis, or any bright, colorful fungus. By the time he was five, he could find chanterelles better than any of us. For one thing, he was shorter and closer to the mushrooms and had young, sharp eyes. He was also fast on his feet and could climb over downed trees, crawl through thick shrubs, and call out "chanterelles!" when he saw their bright orange color.

If you take your children on family mushroom hunting trips, teach youngsters the really toxic ones and the ones that are edible with no look-alikes, such as turkey tails. Of course, caution them not to eat anything until you check the harvest first. Then go home and cook the bounty together for dinner. Spark a lifelong interest in mushroom hunting in the forest, and children are much more likely to get out in nature and remember how important it is to protect wild habitats for future generations.

ABOVE: My son, Ken, was fascinated with fungi from a young age.

ABOVE: On this outing, Ken found four prince mushrooms — *Agaricus augustus*.

POPULAR EDIBLES WITH TOXIC RELATIVES

At some point, you may be interested in expanding your wild mushroom palette beyond the species most people start-foraging — safe species that are difficult to confuse with toxic ones. The mushrooms listed below are widely collected and eaten by experienced foragers, but they do have toxic relatives. If you choose to forage them, be absolutely certain to identify them carefully (including verifying the habitat, time of fruiting, and spore print) using a reliable, current field guide; consult with an expert in person; and taste only a small amount of the mushroom to start. Eat only a teaspoonful or two of the cooked mushroom to begin with. Store the rest in the refrigerator and eat a few tablespoons the next day. If you don't experience any nausea or gastrointestinal distress, then you can consider the mushrooms safe to eat.

ABOVE: *Ramaria araiospora*

Edible Agaricus

Agaricus is the genus of the common button mushroom (and thus the portabello mushroom: both are *A. bisporus*), as well as the wild meadow mushroom (*A. campestris*), also known as the

“pink bottom” (so called because gills of the young mushrooms are pink). It contains some of the best edibles, but also some that look similar — they look a lot like small portabellos, so can be inviting — but are quite nauseating. My first (and only) really bad experience eating wild mushrooms involved agaricus; after eating one, I awoke in the night feeling very nauseated, throwing up a few times as well. Since I’ve learned to identify them more carefully, I’ve eaten lots of agaricus, and they are among my favorites — especially the prince mushroom (*A. augustus*), red-staining *A. subrutilescens*, the meadow mushroom (*A. campestris*), and the delightful, firm *A. lilaceps*. For more information on how to tell the edible species apart from the toxic ones, turn to Identification in the Wild.

Porcini and Other Edible Boletes

Poricini (*Boletus edulis*) is arguably the world’s most beloved edible mushroom. It is large, and when young and firm, it has a fantastic texture and mild flavor after cooking. The sporocarps can be sliced and dried and stored for years; the flavor and aroma can even increase with age. This species contains quite a lot of beta-glucans, so it is immunologically active in addition to being delicious. For information on identifying porcini, turn to the profile.

The butter bolete (formerly *Boletus* aff. *regius,* now *Butyriboletus regius*) is another choice edible, but one that could potentially be confused with a toxic species — Satan’s

bolete (formerly *Boletus satanus,* now *Rubroboletus eastwoodiae,* a potentially deadly species). These two, and other members of the genus *Boletus,* stain blue when cut. The butter bolete has butter-yellow pores and pink flushes on top of the cap, whereas Satan's bolete has a white cap, red pores, and often a red stalk.

CANDY CAPS

Lactarius fragilis

Russulas and Milky Caps

These two white-spored genera are related, having waxy, brittle gills that snap and crackle when broken around your ear. They have many different colored caps and are ubiquitous under trees. The genus *Lactarius* exudes milky sap when the sporocarp is sliced or torn. Some species of both genera are very good edibles if mild tasting (such as the *Lactarius deliciosus* group — delicious milky cap, which might as well be called the "not-so-delicious milky cap"). Taste a very small piece of the bottom stem and a gill — smack it a bit to release the taste; if acrid, spit the piece out and don't eat further.

Blewits

Clitocyboid fungi are a large group of small to medium mushrooms with white, yellowish, or pinkish spore prints. They mostly grow in coniferous forests, in duff, grass, or moss, and have caps that are often funnel-shaped or depressed in the center. Some species have an aniselike or sweet odor when crushed, and a few of these are considered edible and good to eat (*Clitocybe fragrans* and *C. odora*). The popular blewit (formerly *C. nuda*, now *Lepista nuda*) has dull pink spores and is a good edible, though it's severely toxic when eaten raw or undercooked. Several grass-inhabiting species are considered toxic, and many of the rest in the genus are of confusing taxonomy and not worth picking. Leave them all to rot in the forest and spread their spores, with the possible exception of

the blewit: Its gill area smells like opening a new can of frozen orange juice!

BLEWIT

Lepista nuda

Ramaria Species

These are the coral mushrooms, and they come in all colors — purple, red, brown, white, and yellow. They do appear like long-stalked and branched coral, but they grow on the ground in leaf duff rather than in the sea. Ramaria is a popular edible. In

my experience, if the species being considered has a thick base and short branches on top, and it is mild tasting (not bitter), then it is likely edible and can be quite good. Two of the most common of these are *Ramaria botrytis* (pink-tipped coral) and *R. rasilispora* (yellow coral). I have eaten both with pleasure. The drawback is they are hard to clean because duff and dirt lodges between the branches. Best to cut them up vertically to separate the branches and wash forcefully with a spray of water, then dry or cook. Usually, the inedible coral mushrooms are the ones that have long, slender branches coming far down, separately from a base that is not thick and firm; that are bitter; and that stain brown when rubbed. These have been reported to cause gastrointestinal irritation with nausea and diarrhea. The first time you eat a coral, cook only a tablespoonful for the first meal and wait overnight before eating a larger serving. Still, they are among my favorites.

GROWING MUSHROOMS AT HOME

If you live in a city where woodsy areas are scarce and it's a long drive to get to mushroom-hunting areas, you can still grow a variety of mushrooms at home. The excitement of seeing oyster mushrooms popping up out of a straw block or tube in the kitchen, on a balcony, or out in your yard is worth the effort.

You have two options. You can inoculate a substrate, such as straw or wood shavings, with spawn (small pieces of substrate that have been colonized with mycelium) and wait for the mycelium to grow out. Alternatively, you can buy a kit, in which the substrate has already been pasteurized and mixed with the spawn in a convenient container.

Species to Cultivate

Quite an assortment of mushrooms can be grown at home. Oyster mushrooms (various *Pleurotus* species) are perhaps the most commonly cultivated, but other species can be as well — including shiitake, maitake, clamshell mushrooms, beech mushrooms, various types of wood ears (also called *mu er*), enoki and tea tree mushrooms (*Cyclocybe aegerita*, also known as the poplar mushroom or pioppini), chicken leg mushrooms, straw mushrooms, split gills, and lion's mane. Although these are mostly cultivated for their edible and nutritional value, many are considered medicinal and healing as well. Kits are available for growing reishi.

Choosing a Growing Substrate

To grow mushrooms, choose a substrate — the medium on which mushrooms are grown — that's best for the species you'd like to grow. Straw is the most versatile and can be used for growing many kinds of fungi, and it doesn't require full sterilization and inoculating in a flow hood (a sealed box with

inserted gloves and a HEPA filter that is kept sterile and used for inoculating sawdust or wood chips). Wood-based substrates, such as sawdust, are especially good for fungi that naturally inhabit wood, such as reishi, turkey tails, or shiitake. Coffee grounds are also used for shiitake and oyster mushrooms but are easily contaminated. Growing on wood requires a hood and some practice with sterile technique. The best mushroom for inoculating outdoor wood chip beds is king stropharia (*Stropharia rugosoannulata*). Psilocybin mushrooms such as *Psilocybe azurescens* can also be grown outdoors on wood chips.

STRAW. This is the best all-around substrate, because it is easy to buy and nutritious for a number of mushroom species such as oysters, some *Agaricus* species, and the black poplar mushroom piopinni (*Cyclocybe aegerita*). Straw breaks down easily, especially when cut into short lengths. Rice straw is the most efficient for growing many kinds of fungi; if it's not available, opt for wheat or oat straw. I buy mine in large bales for under $10 at my local garden and feed store. Before inoculating it with spawn, you must pasteurize the straw. This will kill many of the competing fungi, while still retaining beneficial microbial species that will further suppress species that lead to spoilage. (See the step by step.)

LOGS. Hardwood logs can be inoculated with plugs of spawn (see the step by step) or with sawdust spawn; plugs are more expensive and don't contain as much actual mycelium, but are convenient to use.

ALTERNATIVE SUBSTRATES. Other substrates, such as sawdust or wood chips, can also be used, especially for fungi like reishi, turkey tails, or shiitake, which naturally inhabit wood. Mix 20 parts of sawdust or finely shredded hardwoods with 2 parts of wheat bran and 1 part of gypsum. The mixture is sterilized in a pressure cooker, mixed with commercial spawn, and then stuffed into plastic bags using sterile techniques — hands should be clean or covered with latex or nitrile gloves, utensils are simmered for 20 minutes, and surfaces are wiped down with ethyl alcohol.

COMMERCIAL KITS. Commercial kits are an easy way to start cultivating mushrooms. The substrate has already been pasteurized, mixed with the spawn, and packed into a convenient container, perhaps a tight-fitting plastic bag or a box. Simply follow the instructions. Depending on how well the mycelium has consumed the substrate when you receive the kit, you can start getting fruiting bodies within a week. I've even seen kits for sale in which the mycelium has completely consumed the substrate and a mushroom or two are starting to develop.

ABOVE: Lion's mane growing on wood chips

MEASURING WITH A MOISTURE METER

If you frequently grow shiitake or other fungi, whether on straw, ground-up wood, or logs, you may want to invest in a moisture meter. Many are available online at low cost with two sharp probes, or one longer probe. You insert the spikes into hay, sawdust, or logs to determine the moisture content.

According to the *Kentucky Shiitake Production Workbook* by Deborah Hill, the ideal moisture in logs or straw (if your variety grows well on this substrate), is at or greater than 35 percent. Shiitake spawn and mycelium cannot survive if the moisture falls below 23 percent. George Vaughan, a long-time mushroom grower, told me that he has actually never used a moisture meter. They might be useful for those with no experience when starting out, but he feels that most people eventually get a feel for the best moisture conditions.

Ideal Conditions for Growing Mushrooms Outdoors

Outdoor mushroom cultivation is generally done with logs. If you happen to live in a climate where summer rain occurs (ideal conditions for growing shiitake or many other species of mushrooms outdoors), you should have an easy time sustaining long-term growth on the same logs, once they are

properly inoculated. Dry, hot climates are generally not conducive to mushroom cultivation outdoors.

ABOVE: Hardwood logs cut from live trees can be drilled and inoculated with spawn to produce mushrooms. The holes are covered with wax to help the log retain moisture.

SHADE. You can stack the logs or lean them against each other vertically in the shade, under trees where they are less likely to dry out quickly.

MOISTURE. It almost goes without saying that fungi need plenty of moisture to thrive. I have seen people try to grow shiitake in dry climates a number of times, with limited success. Fruiting was spotty and did not carry on for years as it could in wetter climates. If you live in Phoenix, for example, good luck to you. In that case, it's best to grow mushrooms indoors.

On the other hand, if you live in a place with summer rain, you are fortunate. My friend Paul Strauss from southeastern Ohio showed me his shiitake logs just lying on the ground in a small swale at the edge of the woods a number of years ago. He had drilled and plugged them, inoculating the logs with mycelium. When I saw them, it was two years later. The fruiting bodies coming out of the logs were abundant and beautiful — a treasure trove of delicious medicine. He told me he could get fruiting bodies two or three times a year for up to seven years. The climate was ideal, because of the warm rains throughout spring, summer, and early fall. The fungi simply went dormant during winter.

The key to successfully cultivating fungi outdoors is to maintain a steady moisture level. Once the logs are dry, they have a harder time absorbing water. During drier months, soak the logs overnight to saturate them. My grower friend George Vaughan tells me that he used to force shiitake logs to fruit by putting them in stock tanks, setting a couple of concrete blocks on top of them to keep them submerged in the water. Putting a sprinkler on them will not penetrate as well, especially if the logs have already dried out, and will often just get encourage weedy species such as turkey tail (a good crop in itself, but it's

not delectable shiitake!). During dry weather, soak logs about once a month. If you live in a climate with summer and early fall rains, your logs may not need extra soaking.

Indoor Cultivation

Most mushrooms grow best in temperatures between 55 and 60°F/13 and 16°C , in a rather moist environment away from direct sunlight, heat sources, and drafts. Some mushrooms, like enoki mushrooms, prefer cooler temperatures: about 45°F/7°C. Others can take warmer temperatures during cultivation, like oyster mushrooms (55 to 65°F/13 to 19°C) and shiitake (between 45 and 72°F/7 and 22°C). Many basements are too warm during summer to cultivate mushrooms but are typically fine during the cooler months.

ABOVE: Cultivated mushrooms provide an income and a source of nutrition for small-scale growers around the world — from Palestine (above) to Malaysia (below).

STEP BY STEP:

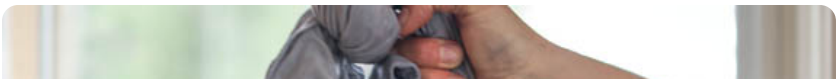
GROWING MUSHROOMS ON STRAW

Oyster mushrooms are an ideal species to start growing at home, especially for the beginner. Ready-to-go spawn is widely available from many mail-order companies, and is easy to grow. Oyster strains come in a number of colors and sizes.

1. Cut the straw into 1- to 3-inch pieces, which will allow the fungus to consume the nutrients faster and speed up the entire process.

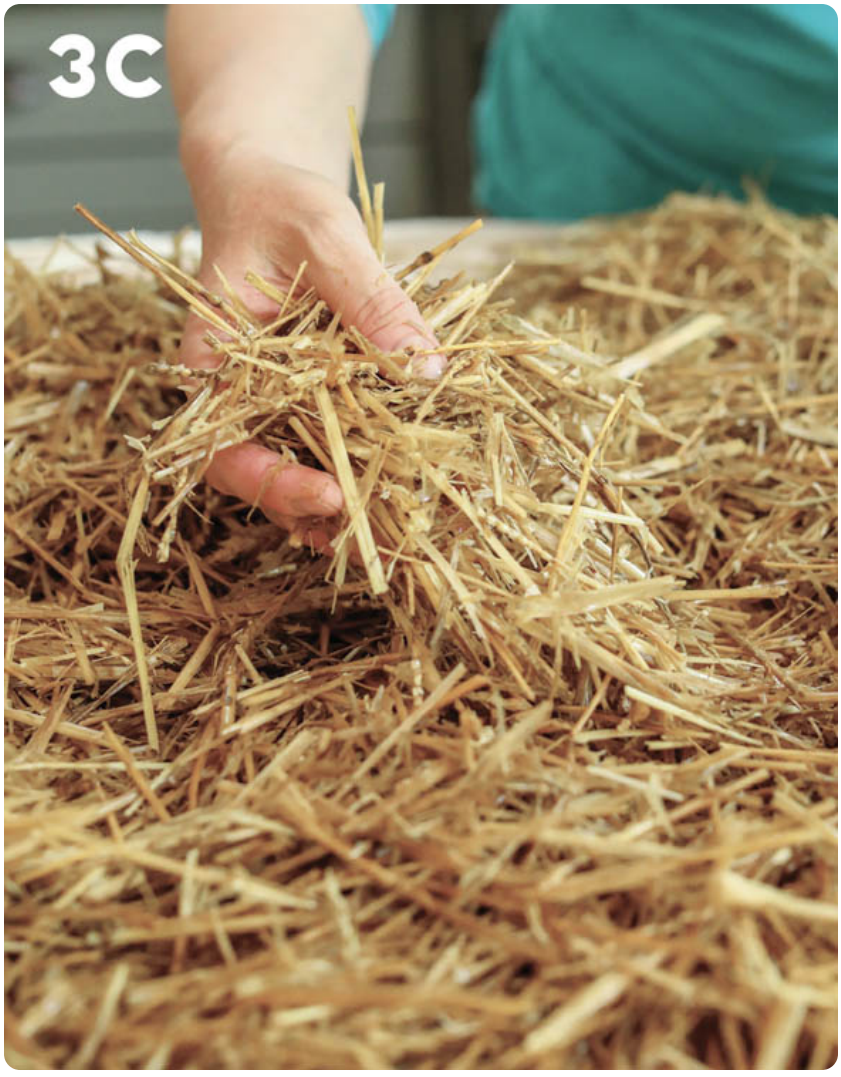
2. To pasteurize the straw, soak it in a nylon bag or pillowcase in a tub of hot water — 160 to 180°F/71 to 82°C — for 1 hour. Use a thermometer to monitor the water temperature and keep it in range.

3. Carefully lift the bag or pillowcase to drain the hot water and allow the straw to cool to room temperature. With clean hands or wearing nitrile gloves, put the straw into a sterilized tub or spread it out onto a clean sheet of plastic or a sterilized countertop. (Sterilize the surface by wiping it with 190 proof alcohol.) Mix the spawn evenly throughout the straw.



3A

3B



4. Pack the spawn-laden straw into a clear plastic bag, canning jars, or a 16-inch-wide length of poly tubing. Poly

tubing is ideal because it can be stuffed to lengths of several feet. This allows you to see what is happening inside; you can monitor for darker areas of obvious contamination, for instance, or observe how the mycelium is progressing at eating up the available food. If you're using tubing, tie one end off with a zip tie and stuff the mixture in until it is firmly packed and has hardly any air pockets. Press the bag to allow more air to escape, then tie the open end closed with another zip tie or stout twist tie. Slice quite a few small holes or X-shaped holes in the tube or bag for the mycelium to breathe and for fruiting bodies to emerge. If you're using canning jars, cover them with a piece of wax paper secured with a rubber band and cut a few small slits in it.

4A

4C

5. Place the bag in a warm, humid location: between 70 and 80°F (21 and 26°C) and 80 percent humidity, if possible. (Consider placing them in a large box next to a seedling heat mat or a temperature-controlled heating pad.) As the days pass, watch the mycelium consume the substrate; eventually it will be mostly grown out with thick areas of pure white mycelium. After about 2 weeks, the mycelium should be fully grown out. To start fruiting, move your batch to a cooler location with some indirect light. Some

people “shock” the batch by tapping on it for a minute or two with a stick or other implement.

6. The small mushroom fruiting bodies will often first occur where you made holes in the poly or wax paper, perhaps every 5 inches or so around the tube or bag, or several places around the jar opening. If the tiny fruiting bodies push up against the bag or paper where no holes exist, simply make a cut to allow them to emerge.

STEP BY STEP:

GROWING MUSHROOMS ON LOGS

If you live in a region with summer rains, you can easily grow a variety of species outdoors, such as shiitake, oyster, lion's mane, and reishi. A lot of good strains are available; George Vaughan, a professional mushroom cultivator I know, recommends a "wide-range strain" that fruits over a long period and can be forced to fruit by soaking. You might try shiitake strain LE46; it runs through the log quickly, is hardy, and responds to shocking (hitting the log with hammer blows).

George also recommends cutting the logs in winter and inoculating in spring. Cut the logs when the trees are dormant, before the sap begins to run and leaf buds start to open. Once the sap is running, the bark becomes loose on the tree. If you cut logs when the sap is running or the leaves are out, the bark will most likely fall off the log within a year; shiitake must have the bark on the log in order to produce.

1. Cut or acquire fresh logs or branches that are 4 to 6 inches in diameter. Do not use downed wood, which is likely to be contaminated with other species of fungi. Oak logs

work the best for shiitake, but you can also use red maple, sugar maple, red alder, or ironwood.

2. Drill holes a little longer than the plugs, 6 inches apart, in staggered rows that are 2 inches apart.

3. Pound the plugs into the log, using a hammer.

4. Coat the holes and the ends of the log with melted cheese wax to help retain moisture.

5. Place the logs in a spot that is out of direct sunlight. Shiitake needs a little light — about 60 to 80 percent shade. Under the tree canopy or a shade cloth is the ideal location.

6. Keep the logs damp. During the first growing season, the logs should be kept moist but not saturated. The moisture content of the logs should be between 35 and 50 percent; maintaining this range is most important during the time the spawn is really taking off.

7. The fruiting bodies should appear after 1 year (or as little as 6 months for oyster mushrooms). If you're getting rain, then you should start seeing fruiting bodies, especially if the temperature and light change. Usually this means cooler temperature and less light, depending on the time of year, but any change could trigger fruiting. It could take longer before mushrooms emerge the first time, but then, if

you’re lucky, you may harvest twice a year for up to 7 years.

GRATITUDE

We learned about gratitude and humility — that so many people had a hand in our success, from the teachers who inspired us to the janitors who kept our school clean . . . and we were taught to value everyone's contribution and treat everyone with respect.

— Michelle Obama

THE OPPORTUNITY TO SHARE my knowledge and experience, and my love of and passion for fungi and the forests and meadows in which they live, fills me with gratitude. These days, amid all the good and bad news of the world, I find myself more and more looking for the silver lining, the positive, the good, the bigger picture, and celebrating the progress we have made as a race. I contemplate what I can do personally to help, even if it's a miniscule piece in the giant picture of life.

I have gratitude for all my teachers and mentors — this is truthfully almost everybody I have known, especially my son. Some have made major contributions at key points in my life,

encouraging my work in the world of fungi, herbal medicine, and healing, and inspiring me to open mental and spiritual doors. These include Pema Chödrön; Rosemary Gladstar; David Arora; Gordon and Valentina Wasson; Bruce Baldwin, my major professor at Cal; many friends and mentors from the Jepson Herbaria; my dad, who was my first teacher and who passed on his love of nature and botany; and my mom, who believed in me, was always there for me, offered her warm and loving support, and told me again and again to let my imagination soar and not to be afraid of failure.

The folks at Storey Publishing were a huge part of the creation of this book. They were professional, easy to work with, and a pleasure to get to know. I'm so grateful to have worked with such a talented team of editors and designers — especially Carleen Madigan and Carolyn Eckert. Our photographer, Tai Power Seeff, was more than a photographer: she is an artist who took painstaking care to make sure her shots had just the right light, ambience, and design, as well as illustrating the practical tips and hands-on medicine-making steps. And thank you to Far West Fungi for generously supplying such a photogenic array of mushrooms for us to shoot.

Peer review is essential for keeping an author honest and for unearthing inconsistencies or mistakes that are sometimes made in the processes of reading so many scientific papers and condensing their essential points and outcomes. I'm grateful to Dr. Solomon Wasser, leading international scientific researcher and publisher of numerous peer-reviewed articles on the medicinal and health-giving effects of fungi around the world. Dr. Michael Beug critically reviewed the manuscript and gave me valuable feedback concerning safety and efficacy for

a number of species. Dr. Phil Carpenter reviewed the ecology and taxonomy sections and provided valuable corrections. Many thanks to George Vaughan at Mushroom Harvest for all of his support and technical expertise. Despite the expert advice from these experienced reviewers, however, I take sole responsibility any for mistakes or misstatements in the text.

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and biological activities. *Journal of Food Composition and Analysis.* 2015;*41*: 165–173.

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RESOURCES

Recommended Reading

General Interest

The Complete Mushroom Hunter by Gary Lincoff. Quarry Books, 2017.

A classic work by a fabulous teacher and author, this guide goes through all the basics of mushroom hunting with humor and passion.

Mushrooms Demystified by David Arora. Ten Speed Press, 1986.

In this groundbreaking work, David Arora's irreverent humor and his articulate, insightful, and exquisitely detailed descriptions of numerous species and their larger allied groups are sure to get you excited about mushrooms. It does pertain mainly to the western United States, however, and because it hasn't been revised since 1986, the taxonomic nomenclature is not up to date.

One Thousand American Fungi by Charles McIlvaine. Dover, 1973.

McIlvaine was the grandfather of modern-day mushrooming, who reportedly foraged and ate more than 700 species of fungi. The taxonomy is very out of date, and the book is more relevant to the East Coast of the United States, but it will still give you fascinating clues for expanding your palette of species.

Field Guides

All That the Rain Promises and More: A Hip Pocket Guide to Western Mushrooms by David Arora. Ten Speed Press, 1991.

Ascomycete Fungi of North America: A Mushroom Reference Guide by Michael Beug, Alan Bessette, and Arleen F. Bessette. University of Texas Press, 2014.

California Mushrooms: The Comprehensive Identification Guide by Dennis E. Desjardin, Michael G. Wood, and Frederick A. Stevens. Timber Press, 2016.

A Field Guide to Edible Mushrooms of California by Daniel Winkler. Harbour Publishing, 2012.

Mushrooms of the Northeast: A Simple Guide to Common Mushrooms by Teresa Marrone and Walt Sturgeon. Adventure Publications, 2016.

Mushrooms of the Northeastern United States and Eastern Canada by Timothy J. Baroni. Timber Press, 2017.

Mushrooms of the Pacific Northwest by Steve Trudell and Joe Ammirati. Timber Press, 2009.

Mushrooms of the Redwood Coast: A Comprehensive Guide to the Fungi of Coastal Northern California by Noah Siegel and Christian Schwarz. Ten Speed Press, 2016.Highly recommended for California coast and outer coast ranges.

Mushrooms of the Southeast by Todd F. Elliott and Steven L. Stephenson. Timber Press, 2018.

Mushrooms of the Upper Midwest: A Simple Guide to Common Mushrooms by Teresa Marrone and Kathy Yerich. Adventure Publications, 2014.

National Audubon Society Field Guide to North American Mushrooms by Gary H. Lincoff. National Audubon Society, 1981.

Visionary Mushrooms

Food of the Gods: The Search for the Original Tree of Knowledge by Terence McKenna. Bantam Books, 1992.
A rollicking exploration of the idea that psychedelic drugs like psilocybin played a role in human evolution.

How to Change Your Mind: What the New Science of Psychedelics Teaches Us About Consciousness, Dying, Addiction, Depression, and Transcendence by Michael Pollan. Penguin Press, 2018.

María Sabina: Her Life and Chants by Alvaro Estrada. Ross Erikson, 1981.

One River by Wade Davis. Simon & Schuster, 1997.
Wonderful take of the amazing travels of Richard Shultes in the Amazon looking for medicinal and visionary plants. Beautifully written and completely absorbing.

Plants of the Gods: Their Sacred, Healing, and Hallucinogenic Powers by Richard Evans Schultes, Albert Hoffman, and Christian Rätsch. Healing Arts Press, 2001.
The classic work on psychoactive plants by two renowned ethnobotanists and Albert Hoffman, who discovered LSD and identified the active ingredients of psilocybe mushrooms.

The Psilocybin Mushroom Bible: The Definitive Guide to Growing and Using Magic Mushrooms by Virginia Haze and K Mandrake. Green Candy Press, 2016.

Psilocybin Mushrooms of the World: An Identification Guide by Paul Stamets. Ten Speed Press, 1996.

Sacred Mushroom Seeker: Tributes to R. Gordon Wasson edited by Thomas J. Riedlinger. Park Street Press, 1997.

Soma: Divine Mushroom of Immortality by R. Gordon Wasson. Harcourt Brace Jovanovich, 1972.

The Wondrous Mushroom: Mycolatry in Mesoamerica by R. Gordon Wasson. McGraw-Hill, 1980.
Wasson and his wife, Valentina, created awareness in the Western world of the ancient shamanistic uses of fungi.

Cultivation

The Essential Guide to Cultivating Mushrooms: Simple and Advanced Techniques for Growing Shiitake, Oyster, Lion's

Mane, and Maitake Mushrooms at Home by Stephen Russell. Storey Publishing, 2014.

Growing Gourmet and Medicinal Mushrooms by Paul Stamets. Ten Speed Press, 2000.

Organic Mushroom Farming and Mycoremediation by Tradd Cotter. Chelsea Green Publishing, 2014.

Biology

The Fungi (third edition) by Sarah C. Watkinson. 2016. Academic Press, 2016.

The Kingdom of Fungi by Jens H. Petersen. Princeton University Press, 2013.

SUPPLIERS

Organic Medicinal Mushroom Suppliers

There are many well-known suppliers who carry the mushrooms and mycelium products mentioned in this book; these are just a few that I recommend because I am personally familiar with their growing methods. For more medicinal and edible mushroom growers who sell whole mushrooms or powders in your area, refer to the links under Medicinal and Edible Mushroom Growers and Cultivation Supplies below.

Far West Fungi

https://farwestfungi.com

Organically grown, fresh and dried, gourmet and medicinal mushrooms

Mushroom Harvest

https://mushroomharvest.com

Organic medicinal mushroom powders and extracts made from mycelium and fruiting bodies grown in the United States

Spring Wind Products

https://springwindproducts.com

Mushrooms used in traditional Chinese medicine, unsulfured, some organic

Spring Wind (for practitioners)

https://springwind.com

High quality dried herbs and some mushrooms commonly used in traditional Chinese medicine

Mushroom Growers and Cultivation Suppliers

The following websites include comprehensive lists of international cultivation resources and suppliers.

Mushroom Grower's Newsletter

https://mushroomcompany.com/farmsonline/

North American Mycological Society

https://namyco.org/mushroom_cultivation_resources.php

Assay Kits

Megazyme

https://www.megazyme.com/beta-glucan-assay-kit-yeast-mushroom

Analytical test for determining levels of beta-glucans, for professional labs set up with a spectrometer, glassware, chemical reagents, and centrifuge

ONLINE RESOURCES

My website

https:// christopherhobbs.com

Many handouts and articles available, as well as a therapeutic database

Organizations

North American Mycological Society

https://namyco.org

Many resources available on the website, including mushroom clubs in your area

Mushroom Identification

Mushroom Expert

www.mushroomexpert.com

All-around useful mushroom site that discusses identification, collecting, and hosts numerous photos.

Mushroom Hobby

www.mushroomhobby.com

Easy to navigate and compare pictures of closely related species

Myco Key

www.mycokey.com

Very cool site with selectable parameters to help you identify mushrooms. Choose cap features, spore colors, size, etc. Mainly European based, but enables you to key out genera for North

American species, and some species are the same on both continents.

Myko Web

www.mykoweb.com

Great pictures and descriptions of California mushrooms

Mushroom Taxonomy

Helpful for determining currently accepted Latin names

Index Fungorum

www.indexfungorum.org/Names/Names.asp

Mycobank

www.mycobank.org

Clinical Trials

Check the databases listed below to keep up to date on new and ongoing clinical trials focused on psilocybin. These include clinical trials on the effectiveness of psilocybin for alcohol dependence, smoking cessation, and depression as well as its effects on religious leaders.

Clinicaltrials.gov

https://clinicaltrials.gov

Multidisciplinary Association for Psychedelic Studies

https://maps.org

ADDITIONAL RESEARCH

Research Gate

www.researchgate.net

Sign up as a user and you can access all of my articles, including full reviews of turkey tail, split gill, and shiitake.

MICRODOSING

Reddit

www.reddit.com/r/microdosing

You can read about many people's experiences with microdosing on Reddit.

METRIC CONVERSION CHARTS

VOLUME

TO CONVERT	TO	MULTIPLY
teaspoons	milliliters	teaspoons by 4.93
tablespoons	milliliters	tablespoons by 14.79
fluid ounces	milliliters	fluid ounces by 29.57
cups	milliliters	cups by 236.59
cups	liters	cups by 0.24
pints	milliliters	pints by 473.18
pints	liters	pints by 0.473
quarts	milliliters	quarts by 946.36
quarts	liters	quarts by 0.946
gallons	liters	gallons by 3.785

US	METRIC

1 teaspoon	5 milliliters
1 tablespoon	15 milliliters
¼ cup	60 milliliters
½ cup	120 milliliters
1 cup	240 milliliters
1 ¼ cups	300 milliliters
1 ½ cups	355 milliliters

WEIGHT

TO CONVERT	TO	MULTIPLY
ounces	grams	ounces by 28.35
pounds	grams	pounds by 453.5
pounds	kilograms	pounds by 0.45

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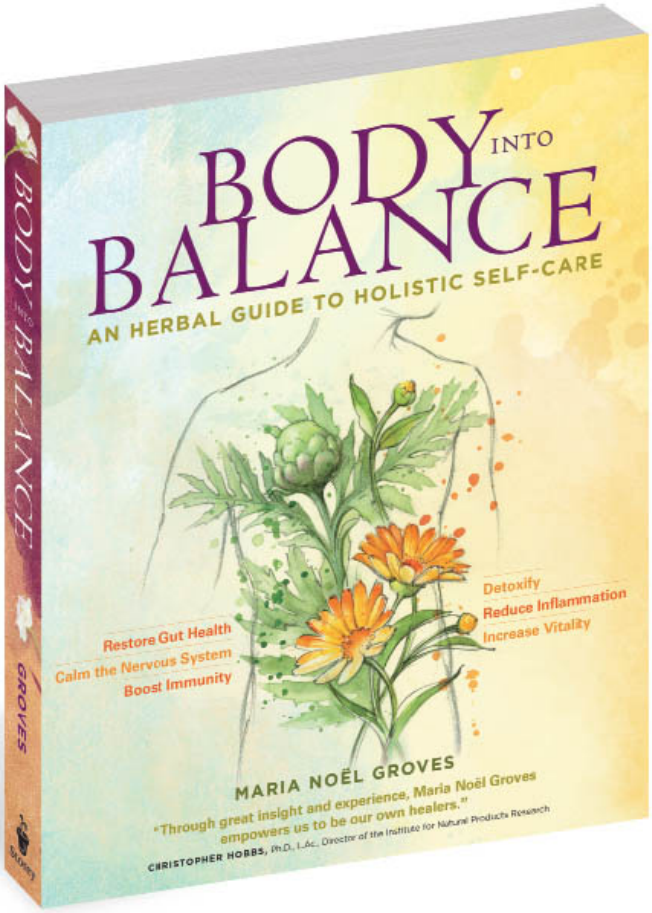
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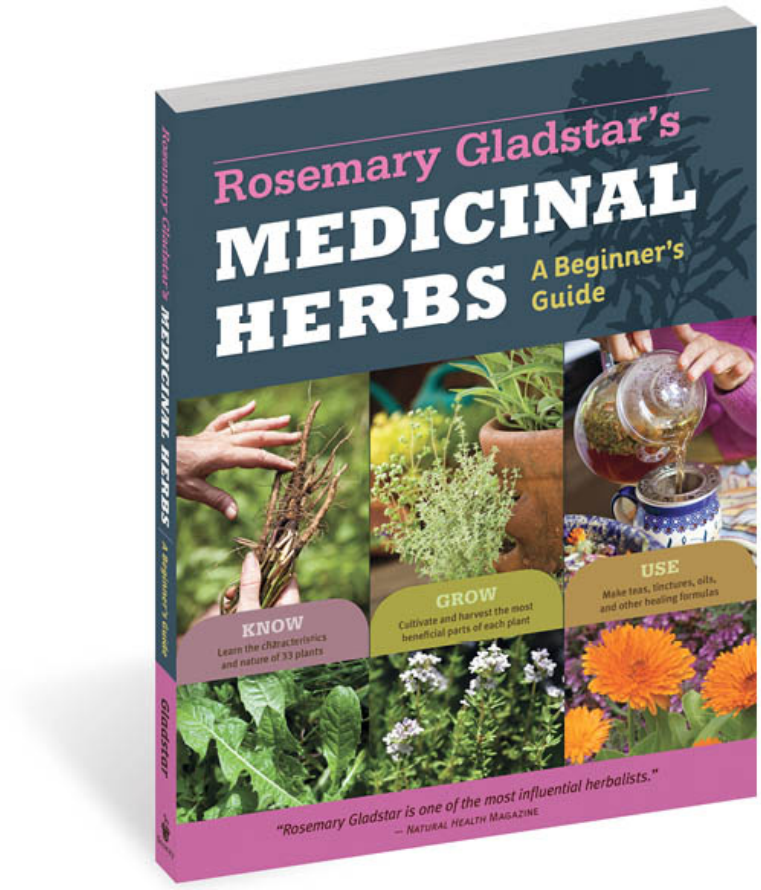

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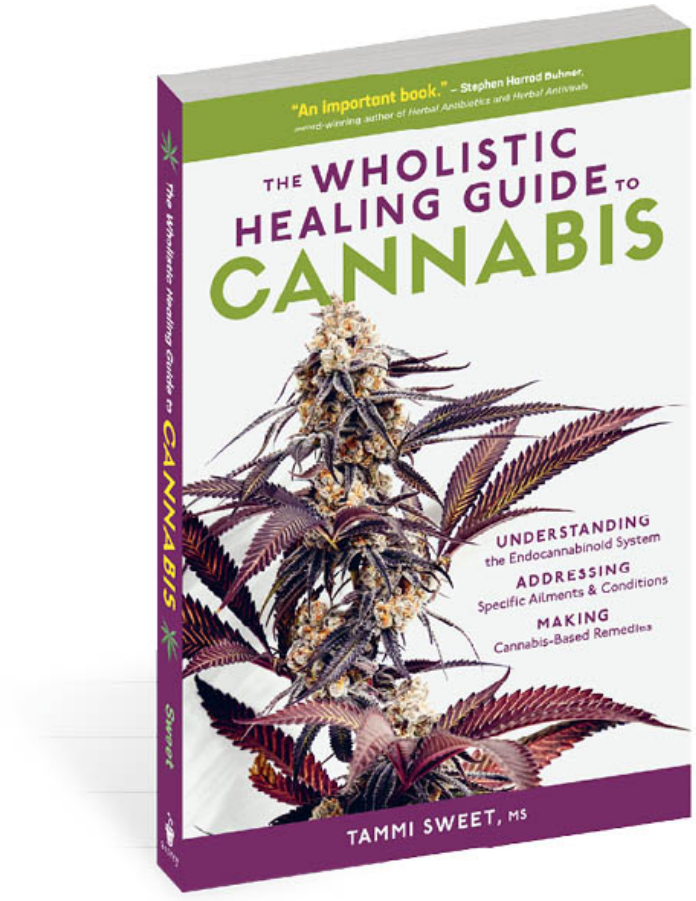

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